# Remedial Action 30% Design Report

# Beloit Corporation Site
# Rockton, Winnebago County, Illinois

**Illinois EPA ID: L2010355004**

**Illinois EPA Procurement No.: FLS-1304.18**
**Work Order No.: 1**

**April 2007**

**Prepared for:**

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# List of Acronyms

| | |
|---|---|
| 1,1,1-TCA | 1,1,1-trichloroethane |
| 1,1-DCA | 1,1-dichloroethane |
| 1,2-DCA | 1,2-dichloroethane |
| 1,1-DCE | 1,1-dichloroethylene |
| 1,2-DCE | 1,2-dichloroethene, 1,2-dichloroethylene |
| amsl | above mean sea level |
| ARARs | Applicable or Relevant and Appropriate Requirements |
| ASTM | American Society for Testing and Materials |
| Beloit | Beloit Corporation Blackhawk Facility |
| BES | Bodine Environmental Services, Inc. |
| BGS | below ground surface |
| BLRA | Baseline Risk Assessment |
| CAC | Corrective Action Contractor |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CHSP | contractor health and safety plan |
| cm/sec | centimeters per second |
| COC | chemical of concern |
| CUO | cleanup objective |
| DMR | Discharge Monitoring Report |
| DOJ | United States Department of Justice |
| EE | engineering evaluation |
| E & E | Ecology and Environment, Inc. |
| EEEI | Ecology and Environment Engineering, Inc. |
| EPA | United States Environmental Protection Agency |

## List of Acronyms (Cont.)

| | |
|---|---|
| ESD | Explanation of Significant Differences |
| FS | feasibility study |
| FSP | Field Sampling Plan |
| gpm | gallons per minute |
| HDPE | high-density polyethylene |
| HOA | hand/off/auto switch |
| hp | horsepower |
| IAC | Illinois Administrative Code |
| Illinois EPA | Illinois Environmental Protection Agency |
| I/O | input/output |
| ISCA | Interim Source Control Action |
| kVA | kilovolt-ampere |
| MCLs | maximum contaminant levels |
| mg/L | milligrams per liter |
| MW | monitoring well |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| O&M | operations and maintenance |
| OSHA | Occupational Safety and Health Administration |
| P&ID | Piping and Instrumentation Diagram |
| P&T | pump-and-treat (system) |
| PCE | tetrachloroethene, tetrachloroethylene |
| PLC | programmable logic controller |
| PRG | preliminary remediation goal |
| psi | pounds per square inch |
| PV | pore volume |
| PVC | polyvinyl chloride |
| QAPP | Quality Assurance Project Plan |
| RA | remedial action |
| RCRA | Resource Conservation and Recovery Act |

## List of Acronyms (Cont.)

| | |
|---|---|
| RD | remedial design |
| RI | remedial investigation |
| RI/FS | remedial investigation/feasibility study |
| RMS | root mean squared |
| ROD | Record of Decision |
| SAI | Source Area Investigation |
| SDR | standard dimension ratio |
| site (the) | Beloit Corporation Blackhawk Facility |
| Soterion | Soterion/United Recovery facility |
| SOW | Scope of Work |
| SVE | soil vapor extraction |
| SVOC | semivolatile organic compound |
| TACO | Tiered Approach to Corrective Action Objectives |
| TCE | trichloroethene, trichloroethylene |
| µg/L | microgram per liter |
| USGS | United States Geological Survey |
| VAC | volts alternating current |
| VDC | volts direct current |
| VOC | volatile organic compound |
| WP | work plan |

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goals

Health & Safety Plan should specify who has authority to stop work at site.

NPDES

Final drawings must be certified and calcs by a Prof Engineer

# 1 Introduction

This document was prepared for the Illinois Environmental Protection Agency (Illinois EPA) under Professional Services Agreement Number FLS-1304, Amendment No. 18, Work Order No. 1, dated December 27, 2005, between Illinois EPA and Ecology and Environment, Inc. (E & E).

Under this work order, E & E was tasked to develop a 30% Remedial Design (RD) Report for the Beloit Corporation Blackhawk Facility (Beloit) site located in Rockton, Winnebago County, Illinois. The 30% RD Report documents the overall management strategy for performing the design, planning the remedial action (RA), and developing a long-term operations and maintenance (O&M) program, pursuant to the final remedy set forth in the Record of Decision (ROD) for the Beloit site (Illinois EPA 2004).

Ecology and Environment Engineering, Inc. (EEEI), E & E's wholly owned, Illinois-licensed engineering subsidiary, developed this document. This RD Report was developed in accordance with the Remedial Design Work Plan (E & E 2006).

The Illinois EPA is the lead agency and the United States Environmental Protection Agency (EPA) is the support agency for this site.

## 1.1 Purpose of the Design Report

The purpose of this 30% Design Report is to compile, for Illinois EPA review and approval, all functional and technical requirements and all provisions applicable to the remedial action, which include the following:

- Work plan assumptions and parameters, including technical and functional restrictions based on results of the Source Area Investigation (SAI) and the Interim Source Control Action (ISCA) Engineering Evaluation;

- Outline of required specifications and determination of the need for detailed equipment, procedures, and materials specifications versus performance specifications;

- Design calculations including determination of performance efficiencies for treatment systems' unit processes and equipment;

- Preliminary plans showing site and equipment layouts, process flows, and locations of construction activities;

- Initial requirements for equipment and identification of long-lead procurement items;

- Determination of governing disposal, emission, and discharge requirements; and

- Identification of the need for additional regulatory agency permits, coordination with outside agencies, site access agreements, and easements.

EEEI will incorporate Illinois EPA comments on the 30% Design Report submittal into the 95% RD Report package. Any adjustments to the scope and direction of the project requested by Illinois EPA will be discussed and agreed upon between EEEI and Illinois EPA so that any major revisions can be incorporated prior to submission of the 95% RD documents. EEEI will coordinate, check, and proof the plans and specifications for accuracy and completeness. In addition to all of the documentation provided in the 30% RD, the 95% document submittal will also include:

- Initial capital and O&M cost estimate;

- Construction schedule;

- Construction quality assurance objectives;

- Substantial requirements for Contractor Health and Safety Plans (CHSPs); and

- Draft O&M Plan.

Upon receipt of Illinois EPA comments on the 95% RD, EEEI will incorporate the comments and prepare and submit the final RD documents to Illinois EPA. All RD documents will be comprehensive and complete so that bidding packages can be prepared and provided to remediation contractors. The final RD documents will include all of the 95% RD documentation, revised as agreed upon with Illinois EPA, plus the final cost and construction-related items as follows:

- Final capital and O&M cost estimate;
- Final construction schedule;
- Final construction quality assurance objectives; and
- Substantial requirements for CHSPs.

The final remedial design will be a comprehensive set of specifications designed to meet the cleanup objectives (CUOs) established in the ROD for the Beloit site. Illinois EPA will hold the contract with the selected remedial action contractor(s). The CHSP(s) will be prepared by the remedial action contractor(s) selected to perform the tasks as required by the plans and specifications. The specifications prepared by EEEI will state the requirements of the CHSPs. Additionally, EEEI will finalize the O&M Plan following Illinois EPA comments; however, upon completion of site construction activities by the Illinois EPA Corrective Action Contractor (CAC), Bodine Environmental Services, Inc. (BES), the O&M Plan will require additional review.

This 30% Design Report is composed of seven sections. Section 1 presents the introduction, purpose, and basis for development of the Design Report. Section 2 summarizes background information about the Beloit site and provides an overview of the existing site conditions. Section 3 delineates the groundwater treatment zones as defined by the SAI, and Section 4 discusses the current treatment system and findings from the ISCA Engineering Evaluation. Section 5 presents the proposed treatment system design, and Section 6 describes additional considerations for the remedial action. Section 7 is a list of the references used in this report.

## 1.2 Basis for the Design Report

The RA at the Beloit site is based on the Scope of Work (SOW) provided by the Illinois EPA, which was incorporated into E & E's RD Work Plan (WP; E & E 2006). Some of the tasks listed in the WP have been completed under the O&M activities provided by BES.

# 2 Site Background

## 2.1 Site Description

The Beloit Corporation's Blackhawk Facility (the site) is located in Rockton Township in north-central Illinois. This National Priorities List (NPL, or Superfund) site occupies part of the northern half of Section 13 and the southeast quadrant of Section 12, T46N, R1E, Winnebago County, Illinois.

The site is bounded on the north by Prairie Hill Road, on the west by the Rock River, on the south by a line projected from the Rock River along the south edge of a village of Rockton easement and access road (for the village water tower) to Blackhawk Boulevard, and on the east by Blackhawk Boulevard (Figure 2-1). The NPL site area includes the Beloit Corporation property, the neighboring Blackhawk Acres subdivision, the former Soterion/United Recovery facility (Soterion), a portion of the Taylor, Inc. property, and the Safe-T-Way property.

## 2.2 Site Geology and Hydrogeology

Regional geology and hydrogeology information was obtained from the ROD and the remedial investigation and feasibility study (RI/FS). Source area geology and hydrogeology information was taken from the Source Area Investigation Technical Memorandum (E & E 2007). The SAI fieldwork was performed in December 2006 and concentrated on characterizing the source area adjacent to the Erection Bay.

## 2.3 Regional Geology and Hydrogeology

The site is located over the ancestral Pecatonica-Sugar Rivers Bedrock Valley, where it merges with the Rock River Bedrock Valley. The glacial deposits beneath the site consist of a coarse upper outwash, primarily in the vadose zone; a fine-grained middle outwash, typically at or below the water table; and a coarse-grained lower outwash, which is bounded below by a lacustrine clay deposit that extends laterally beneath the site. The shallow aquifer identified at the site consists of the outwash deposits present above the lacustrine clay unit. The depth to groundwater, generally unconfined across the site, is approximately 20 feet. In general, groundwater flow is toward the southwest and south, ultimately discharging to the Rock River south of the village.

The groundwater at the site and within the village of Rockton meets the standards of Title 35 Illinois Administrative Code (35 IAC) Part 620.210 Class I, Potable Resource Groundwater.

The Remedial Investigation (RI) report provides hydraulic conductivity data for the middle outwash deposits estimated from bail-down slug tests conducted in 16 monitoring wells across the site, including wells W23 and W23B at the Erection Bay. Hydraulic conductivities ranged from 1.8E-2 centimeters per second (cm/sec) to 9.6E-6 cm/sec, with a geometric mean of 5.5E-4 cm/sec. At the Erection Bay, hydraulic conductivities for W23 and W23B were reported as 6.8E-3 cm/sec and 1.0E-4 cm/sec, respectively.

## 2.4 Source Area Geology and Hydrogeology

Glacial deposits beneath the Erection Bay consist of a coarse upper outwash, primarily in the vadose zone, and a finer-grained middle outwash, typically at or below the water table. Soil materials observed in boreholes from the SAI were generally consistent with the geologic conditions observed and reported in the RI report.

From the ground surface to 20 to 25 feet below ground surface (BGS), the upper outwash consists primarily of poorly sorted, well-drained, fine to coarse sand and fine to coarse gravel with occasional laterally discontinuous silty sand and silt intervals. Cobbles are frequently encountered in the upper outwash. This unit was difficult to penetrate with the drill rig due to the cobbles and the tendency for collapse, resulting in loose and unconsolidated cores.

The upper outwash is underlain by the finer-grained middle outwash observed at a depth of 20 to 25 feet BGS and consisting of a very dense, brown to yellow-brown sandy silt, interbedded with occasional thin sand, gravel, or silt seams. The middle outwash is observed to a depth of 50 to 55 feet BGS. Retrieved soil core materials were typically highly consolidated, with a cemented matrix. Occasional horizontally oriented fractures were observed.

The water table was measured in the middle outwash in monitoring well W23 at a depth of approximately 26 feet BGS. Groundwater was rarely observed in a borehole during drilling, however, suggesting that the middle outwash below the Erection Bay is a relatively lower-conductivity zone than other areas south of the Erection Bay. Groundwater flow in the middle outwash appears to be primarily by fracture flow.

Analysis of drawdown data from the pumping test at EW01, using wells W23 and W23B as observation wells, was performed during the SAI. The estimated hydraulic conductivity calculated from this test was 7.6E-4 cm/sec. Extraction well recovery data yielded a calculated hydraulic conductivity value of 2.2E-4 cm/sec. Both of these pump test hydraulic conductivity values are similar to the geometric mean value calculated from the RI data (5.5E-4 cm/sec). This suggests that the geometric mean value is a good estimator of the hydraulic conductivity for the middle outwash in the Erection Bay area.

## 2.5 Site History

The manufacturing facility formerly owned by the Beloit Corporation comprises the majority of the site. The Beloit Corporation is a former manufacturer of machines that produced layered paper products from paper pulp. The use of solvent for machine parts cleaning at the Beloit Corporation plant was identified as the source of groundwater contamination.

In June 1999, the Beloit Corporation filed for bankruptcy. In February 2002, EPA, the United States Department of Justice (DOJ), and Guiffre II, LLC, the new owner of the property located within the Beloit Corporation site, signed a settlement agreement under Section 122(h) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The State was also a party to and signed the agreement in April 2002. The new property owner uses the site as a transfer station for drywall and other building materials.

## 2.6 Summary of Previous Site Investigations

In the early 1980s, the Illinois EPA investigated United Recovery and private water supply wells located in the Blackhawk subdivision. The discovery of volatile organic compounds (VOCs) [primarily tetrachloroethene (PCE) and 1,1,1-trichloroethane (1,1,1-TCA)] in residential groundwater led to subsequent groundwater quality studies and the inclusion of the Beloit Corporation site on the NPL. Pursuant to a consent decree, the Beloit Corporation was required to complete an RI/FS, which included the Beloit Corporation property.

During the RI, soil, soil gas, and groundwater quality data was gathered by Montgomery Watson Americas, Inc., consultant to the Beloit Corporation (Montgomery Watson 1999). Because of elevated concentrations of PCE in groundwater from monitoring wells W23/W23B and W36C and in vicinity soils, the southern area of the Erection Bay is believed to be the source area for the On-Property Groundwater Plume. High levels of PCE in groundwater have been persistent at this location, despite implementation of the ISCA pump-and-treat system and placement of an extraction well (EW01) in the vicinity. In the RI report, Montgomery Watson estimated the dimensions of the Erection Bay source area (groundwater VOCs in excess of 1,000 micrograms per liter [μg/L]) to be approximately 100 feet by 120 feet (12,000 square feet), and conservatively estimated that the plume in this area extends to a depth of 60 feet BGS.

Based on the RI, the Illinois EPA determined that the VOC contamination of groundwater originates on the Beloit Corporation property and extends via a plume into the Village of Rockton and the southern portion of the Blackhawk Acres subdivision. A second plume, containing trichloroethene (TCE) and located deeper within the shallow aquifer, originates near the southeast corner of the Beloit Corporation property and extends into the village of Rockton. The source of the TCE plume could not be identified.

A Baseline Risk Assessment (BLRA) was conducted by the Beloit Corporation with oversight by the Illinois EPA. The Illinois EPA conditionally approved the BLRA in December 2000, and Beloit Corporation submitted the final BLRA, with requested revisions, in January 2001.

Based on the RI and BLRA, chemicals of concern (COCs) at the Beloit Corporation NPL site are chlorinated VOCs in groundwater and soil. The VOCs in groundwater on and around the site are distributed into three plume categories that incorporate the five separate areas of VOCs identified in the RI report. These three plume categories are as follows:

- **Groundwater VOC Source Area** – On the Beloit Corporation property near the current location of the Erection Bay.
- **On-Property Groundwater Plume** – On the Beloit Corporation property. This plume includes all the VOC-contaminated groundwater detected in the central portion of the Beloit Corporation property.
- **Off-Property Groundwater Plumes** – Off the Beloit Corporation and NPL site boundaries. This off-property area includes the following groundwater plumes and areas of VOC groundwater contamination, as described in the RI:
  - TCE plume;
  - That portion of the On-Property Groundwater Plume that extends south of the NPL site into the Village of Rockton; and
  - Southern Blackhawk Acres subdivision wells.

In November 2001, the final feasibility study (FS) that discusses and compares the potential cleanup remedial alternatives was completed by the Beloit Corporation. The Illinois EPA conditionally approved the final FS in January 2002.

## 2.7 Previous Remedial Actions

In 1993, the Illinois EPA installed point-of-entry carbon filtration units in residences with impacted wells in the Blackhawk Acres subdivision. The Illinois EPA currently maintains and monitors these systems. The ISCA pump-and-treat system was installed in 1996 by Beloit Corporation, with the approval of the Illinois EPA. The system consists of four extraction wells and an air-stripping tower located in the southeastern corner of the Beloit Corporation property. The system is designed to contain groundwater within the Beloit Corporation property and provide treatment of extracted groundwater by air stripping. Treated groundwater is discharged to the Rock River under a National Pollutant Discharge Elimination System (NPDES) permit, at an outfall located on Beloit property. The VOC groundwater plumes in the Village of Rockton and the Blackhawk Acres subdivision have been naturally attenuating since the ISCA pump-and-treat system was implemented.

BES, a State Procured Corrective Action Contractor, is responsible for long-term groundwater monitoring and O&M associated with the existing ISCA pump-and-treat system. Groundwater monitoring is performed quarterly pursuant to the Action Memorandum for the ISCA and the Removal Action Design Report, both of which are part of the Administrative Record for the site.

## 2.8 Scope of the Final Remedial Action

The final ROD for the Beloit Corporation site was signed in September 2004. The selected remedial action contained in the ROD is a final, sitewide remedy that addresses the groundwater and soil contamination at the site. The ROD specifies that the primary remedy for the site is the existing ISCA pump-and-treat system, which is to be augmented by chemical oxidation of groundwater and soil in the Erection Bay source area, and the installation of additional extraction wells, as necessary. The ROD requires institutional controls to prohibit the installation of potable water wells on Beloit Corporation property until the groundwater is restored to the more stringent of either the federal maximum contaminant levels (MCLs) or State of Illinois Class I groundwater standards for all COCs.

Additionally, monitored natural attenuation of groundwater in the Blackhawk Acres subdivision and in the Village of Rockton is to be performed until the more stringent of either the MCLs or State of Illinois Class I groundwater standards is achieved for all COCs. Groundwater at the Erection Bay and any contaminated soils associated with the source area constitute the principal threats at the site.

In December 2006, pursuant to the ROD, soil and groundwater below and in the vicinity of the Erection Bay were investigated to delineate the area where groundwater VOC concentrations were the highest. This data was to be used to develop a work plan for a chemical oxidation pilot test.

However, results from the SAI identified several factors that mitigated against the implementation of chemical oxidation as a treatment tool for the source area. These factors were reported to the Illinois EPA in a Technical Memorandum (E & E 2007) and include:

- **Extent of the Source Area.** The SAI identified a source area (i.e., an area where groundwater total VOC concentrations are approximately 500 μg/L, or more) that is approximately five times larger than the source area delineated in the RI and evaluated in the FS report. Figures 2-2 through 2-4 show the source area plume size and concentrations for PCE, TCE, and cis-1,2-dichloroethylene, respectively.

- **Soil Conditions in Source Area.** Source area soils were found to be highly consolidated and extremely dense with relatively low permeability, which would make the introduction of an oxidant difficult and would result in poor oxidant transport and decreased efficiency and effectiveness.

- **Potential Cost Increase.** Cost increase due to the increased plume size and multiple injections required to meet cleanup objectives could drive the cost to six times the estimated cost presented in the FS.

Given the results of the SAI, and the factors described above that potentially could inhibit implementation of chemical oxidation, E & E evaluated other technologies that might be viable for addressing the source area. Several technologies were eliminated in the FS report and were not considered further by E & E. These included slurry walls, passive wall treatment, and thermal vapor extraction. Soil vapor extraction (SVE) was screened out due to the lack of VOCs in the vadose zone. Air sparging and dual-phase vapor extraction were considered but eliminated due to some of the same issues surrounding chemical oxidation, i.e., the need for numerous injection/extraction points, poor contact between injected/extracted air and matrix contaminants, and significant infrastructure requirements (piping, blowers, etc.) that could impact facility operations. Enhanced biodegradation was similarly eliminated due to the need to inject substrate for microorganisms, or other solutions to control subsurface redox conditions, and the potential for the generation of vinyl chloride.

The remaining viable technology for the source area was determined to be groundwater extraction and treatment, i.e., the construction of one or more additional extraction wells in the source area and pumping the water to the existing ISCA air stripper. Potential operational and administrative benefits of this approach included:

- The existing air stripper on site has proven to be effective, has the piping to accommodate three additional extraction wells, and has low additional capital costs and a low operating cost.
- Construction of additional extraction wells would cause minimal impairment of ongoing facility operations, and design of additions to the ISCA system could be accomplished under the existing Illinois EPA-approved schedule.
- To increase the effectiveness of additional extraction wells, hydraulic fracturing of well boreholes could be performed prior to well installation, and pulsed-pumping schedules could be employed to maximize the removal of VOCs.
- The ROD included contingency provisions for the construction of additional extraction wells.

Because of these factors, E & E recommended that the Illinois EPA move forward with the design of additional extraction wells for the Erection Bay source area, in lieu of chemical oxidation. Following review of the SAI Technical Memorandum, the Illinois EPA and EPA concurred. Currently, an Explanation of Significant Differences (ESD) is being prepared to document this change to the ROD.

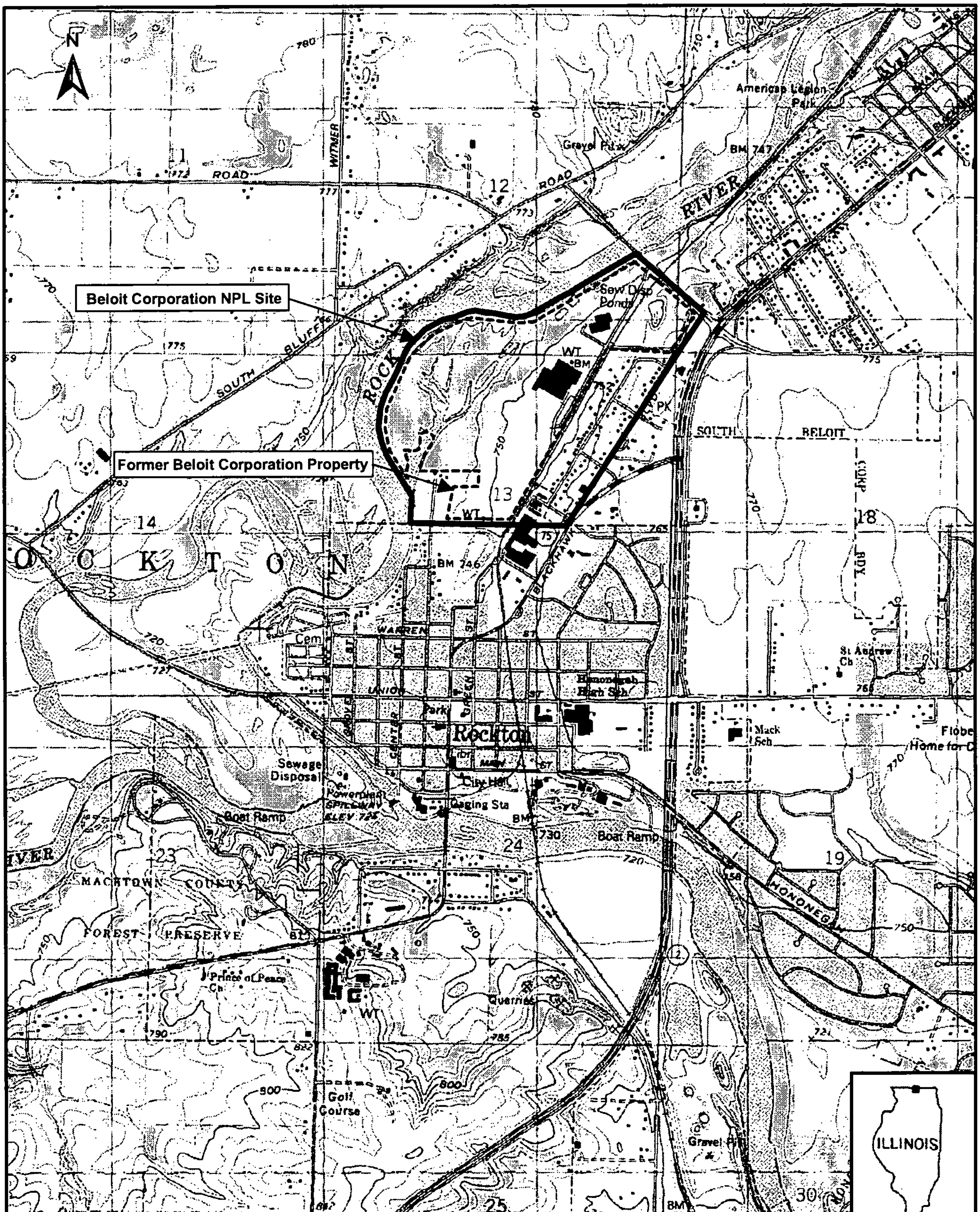


**Figure 2-1**
**Site Location Map, Beloit Corporation Site**

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Source: U.S.G.S., South Beloit, Il-Wis 7.5' Quadrangle, 1993.

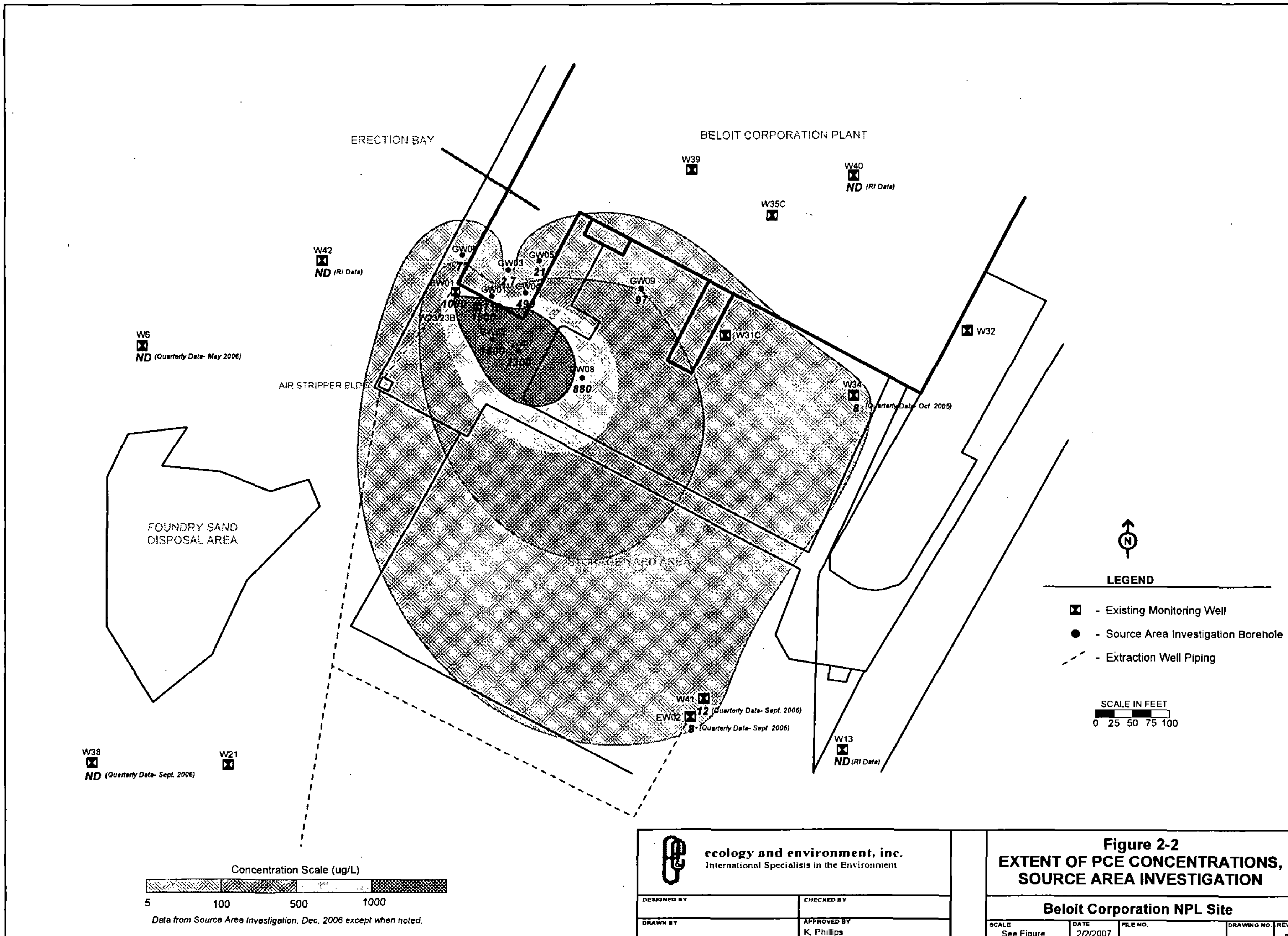



**Figure 2-2**
**EXTENT OF PCE CONCENTRATIONS, SOURCE AREA INVESTIGATION**

**Beloit Corporation NPL Site**

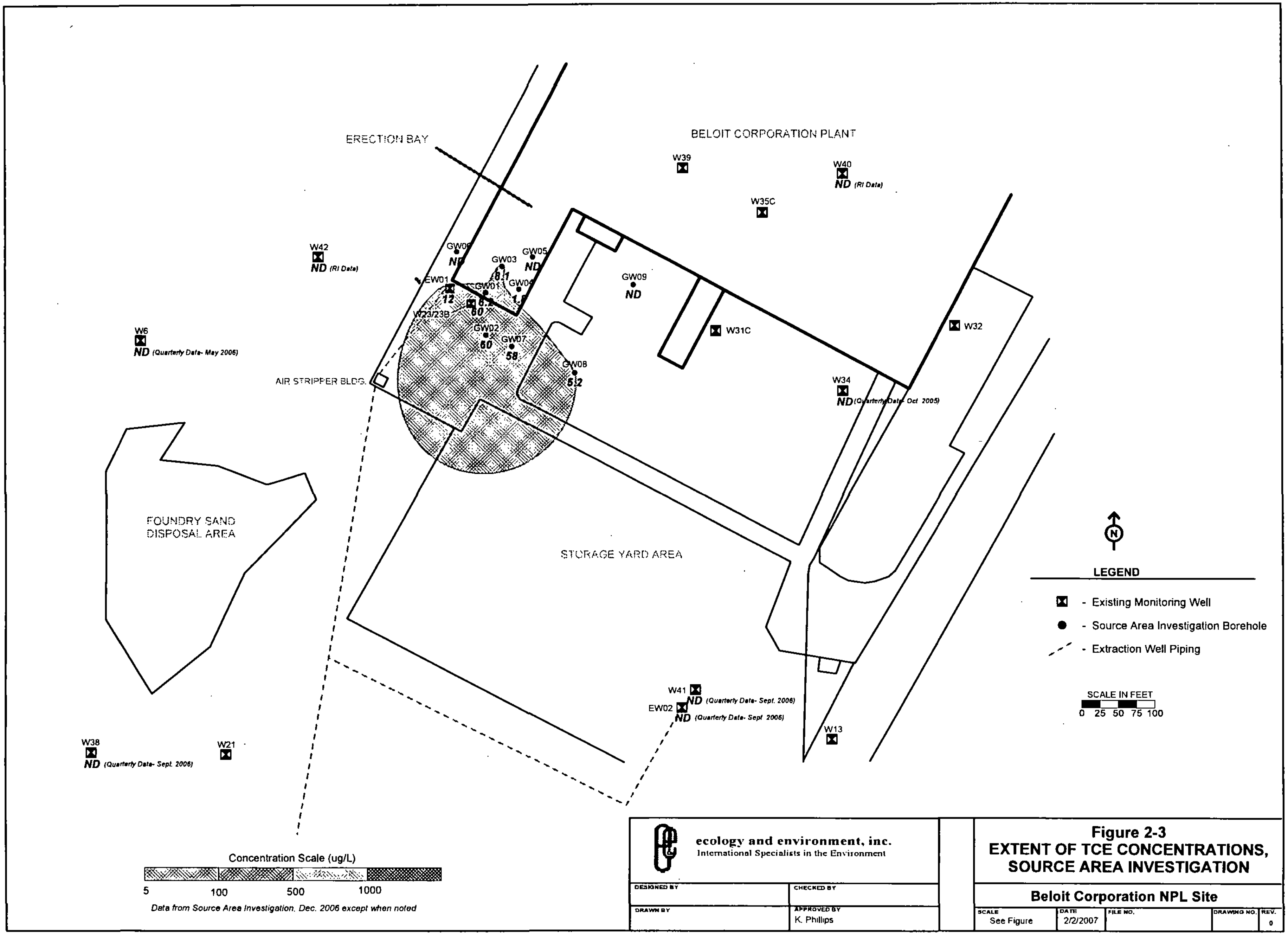
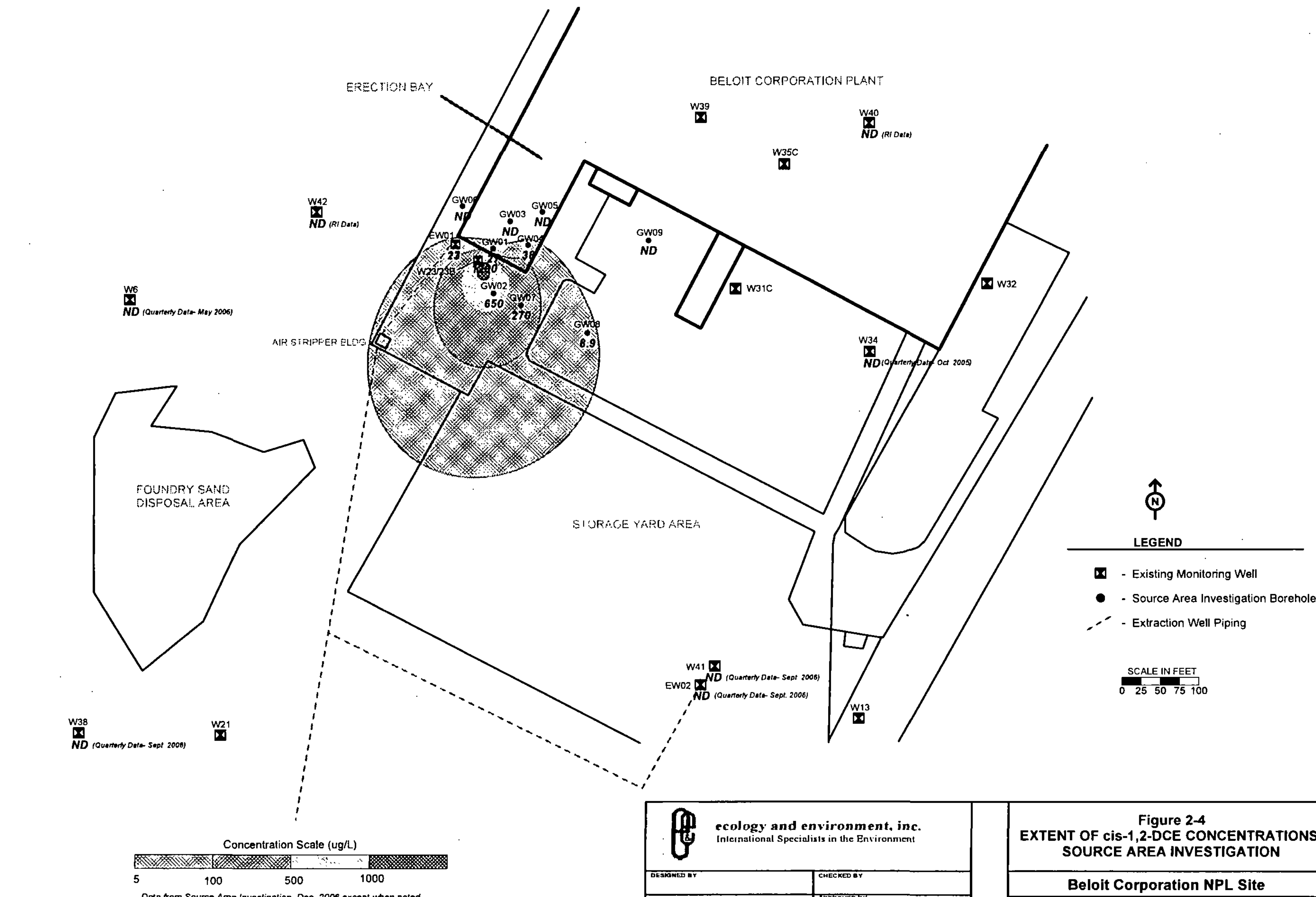


Figure 2-3
EXTENT OF TCE CONCENTRATIONS, SOURCE AREA INVESTIGATION

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| DESIGNED BY | CHECKED BY |
|---|---|
| DRAWN BY | APPROVED BY K. Phillips |

**Figure 2-4**
**EXTENT OF cis-1,2-DCE CONCENTRATIONS, SOURCE AREA INVESTIGATION**

**Beloit Corporation NPL Site**

| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
|---|---|---|---|---|
| See Figure | 2/2/2007 | | | 0 |

# 3 Groundwater Treatment Zone Delineation and Well Layout

Past reports have documented the migration of VOCs released from the vicinity of the Erection Bay, along with groundwater, to the southwest, essentially parallel to the river. The natural discharge area for groundwater originating on the Beloit property would be the Rock River south of the village. However, the ISCA pump-and-treat system has been capturing this groundwater. VOCs within the capture zone of the ISCA pump-and-treat system are removed and treated by air stripping.

The SAI was conducted to determine the vertical and horizontal extent of the source area contamination in an effort to develop a remedial plan that would reduce operating time of the pump-and-treat (P&T) system. SAI activities included groundwater sampling, vadose-zone soil sampling, surveying, water level measurements, and an existing monitoring well survey. In general, all procedures were conducted in accordance with the Illinois EPA-approved Work Plan, Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP) documents prepared by E & E (E & E 2006). The findings of the SAI were reported in the document, Technical Memorandum for Source Area Investigation (E & E 2007).

what about USEPA QAPP approval?

Data on groundwater quality within the Erection Bay source area was collected from existing monitoring wells and from nine borehole locations. Three boreholes were located in areas outside the RI-defined source area based on unanticipated results obtained during the field-screening activities. In order to determine the presence of contamination in the vadose-zone soils within the Erection Bay source area, vadose-zone soil samples were also collected.

The SAI identified a source area (i.e., an area where groundwater total VOC concentrations are approximately 500 µg/L, or more) that is approximately five times larger than the source area delineated in the RI and evaluated in the FS report (Figure 3-1). The FS considered a source area with dimensions of 100 feet by 120 feet (an oval-shaped area of 10,000 square feet). The redefined source area identified during the SAI consists of an oval-shaped area approximately 300 feet by 225 feet (i.e., 54,000 square feet).

There was a lack of chlorinated VOCs detected in vadose-zone soils sampled during the SAI. This finding is consistent with results from the RI. Observations of soil cores taken during the SAI and the SAI analytical results suggest that there is little or no residual vadose-zone soil source contributing to VOCs in groundwater at the Erection Bay. Therefore, the proposed treatment area for the remedial design is the source area groundwater only.

The results presented in the *Technical Memorandum for Source Area Investigation* (E & E 2007) are the primary basis for the design of the groundwater P&T system extension into the Erection Bay source area. Site-specific field data from other reports, including the *Remedial Investigation Report* (Montgomery Watson 1999) and *Quarterly ISCA Status Reports* prepared by Montgomery Watson, Sigma Environmental Services, and BES, were also used to evaluate the current system and design the extension. To simulate potential pumping rates and capture zones for the proposed P&T extension, a groundwater flow model was utilized. Guidance documents, including *Design Guidelines for Conventional Pump and Treat Systems* (EPA/540/S-97/504) and *Standard Guide for Application of a Ground-Water Flow Model to a Site-Specific Problem* (ASTM D 5447-93) were also consulted during the design evaluation.

The procedure for applying the groundwater model included the following steps: define study objectives, select a computer code, construct the groundwater flow model, calibrate the model and perform sensitivity analysis, make predictive simulations, and document the process. Each of these steps is described below.

## 3.1 Study Objectives

The objective for the P&T extension into the Erection Bay source area involves optimizing well locations and extraction rates to maintain effective hydraulic capture within contamination zone(s), minimizing stagnation zones, and maximizing pore volumes pulled through the system, in order to reduce contaminant concentrations to cleanup standards, maximize mass removal, and minimize cleanup time and cost. Using the delineation of Erection Bay contaminant areas described in the Technical Memorandum (Figure 3-1), a capture zone analysis was performed to optimize the P&T design. The analysis allowed evaluation of alternative extraction schemes, and visualization of groundwater path lines and contaminant particle travel times from capture to extraction and treatment.

## 3.2 Model Selection

The software used was FLOWPATH II (Version 1.1), developed by Waterloo Hydrogeologic Inc. FLOWPATH II is a two-dimensional, finite difference, groundwater flow, path line, and contaminant transport modeling package. An earlier version of this software was used in design of the existing ISCA P&T

system. The earlier model results were reported in the Removal Action Design Report (Montgomery Watson 1996a).

## 3.3 Model Construction

Groundwater flow model construction involves the process of transforming important aspects of the physical hydrogeologic system being modeled into mathematical form. Building the model in FLOWPATH II required a base map, definition of a two-dimensional finite difference grid, well locations, aquifer properties, head boundary conditions, and observation points for model calibration. The following is a description of the model input parameters and a discussion of the rationale for the selection of those parameters.

**Unit System:** English units (ft/gal/day).

**Base Map:** The base map for the modeled area was obtained by digitizing portions of Drawing No. F5 from the RI Report, which was developed from an aerial survey performed in November 1990. Consistent with the RI Report, the Illinois State Plane Coordinate System and U.S. Geological Survey (USGS) elevation datum were applied to the model base map.

**Grid Parameters:** The model grid is 83 columns by 58 rows (Figure 3-2). The grid spacing is based on 40-foot grid nodes, with nodes refined to 10 to 20 feet around existing extraction wells and proposed new wells.

**Observation Wells:** Eight monitoring wells were selected from the model area to serve as observation wells and to provide points for matching observed versus calculated heads during model calibration. Average water table elevations measured at each well location prior to installation of the ISCA, were used as the observed heads, with the objective of calibrating the model to pre-pumping flow conditions around the Erection Bay. Water table elevations used in the model were taken from the RI Report and are provided in Table 3-1. No extraction wells were included in the calibration run.

**Aquifer Properties:** Two different aquifer property zones were defined throughout the model. These zones and values are shown on Figure 3-3. To define the zones, bail-down slug test data and geologic cross-section information provided in the RI Report were evaluated for each monitoring well located in the model area. When the RI conductivity data was mapped, it was observed that a zone of higher hydraulic conductivity (i.e., Zone 2, which was one to two orders of magnitude greater) exists along the south and east boundaries of the model area. Wells in this area, with the exception of well W32, were identified in the RI as screened in the coarse upper outwash. The coarse upper outwash is composed mainly of coarse sand and gravel. The geometric mean value for conductivity in Zone 2, based on slug test data, was calculated to be 19 feet/day. A value of

10 feet/day was used in the final calibrated model. Conductivity values in Zone 1 were significantly lower, and correspond to the fine middle outwash defined in the RI Report. The fine middle outwash is predominantly silty sand and silt and has a calculated geometric mean conductivity value of 1.6 feet/day. These aquifer materials and conductivity values were confirmed during the SAI. A pumping test conducted in extraction well EW01 located at the southwest corner of the Erection Bay and screened in the fine middle outwash resulted in a calculated hydraulic conductivity value of 2.1 feet/day. A value of 2.0 feet/day was used in the final calibrated model.

The porosity assigned to each zone is the effective porosity, which is defined as the volume of aquifer material divided by the volume of interconnected pore space available for groundwater to flow. This is always less than the total porosity. A lower effective porosity value of 0.1 was assigned to Zone 1 compared to Zone 2 (0.2) due to the prevalence of silt in Zone 1 aquifer materials.

**Aquifer Bottom Elevations:** The aquifer bottom elevation was designated as the top of the extensive clay unit identified during the RI at a depth of between 60 and 80 feet below the model area. Three zones were blocked out to represent the elevation of a thin clay ridge (690 feet above mean sea level [amsl]) and two transition zones surrounding the ridge (680 and 670 feet amsl). The various bottom elevation zones incorporated into the model are shown in Figure 3-4.

**Boundary Conditions:** The Erection Bay source area is situated in a complex flow field that is significantly influenced by the Rock River, the downstream hydroelectric plant dam/spillway, and a northeast-to-southwest-trending groundwater high located north and west of the Beloit Corporation facility. Figure 3-5 shows the model area superimposed on pre- and post-ISCA water table maps. These maps demonstrate the persistent effect of the groundwater high and the Rock River on the flow field, regardless of ISCA pumping, and the general groundwater contours the model was designed to simulate. Specifying the boundary conditions of the groundwater flow model included assigning a boundary type to every point along the boundary surface of the aquifer system and to internal sources or sinks, in order to simulate the observed flow field.

The Rock River is typically a groundwater discharge area along its length. However, the dam on the Rock River in the village controls the relationship between surface water and groundwater in the area of the pool behind the dam. Where the head in the pool is greater than the head in the groundwater system, surface water is induced to flow from the river into the aquifer. This effect extends upriver to approximately the mid-point of the model area around monitoring wells W6 and W38. These wells represent an inflection point in the flow field where regional groundwater flow toward the river is turned away from the river due to head pressure of the pool.

The groundwater high north and west of the Erection Bay is a divide between flow to the Rock River, to the northwest, and to the Rock River below the dam south of the Village. The groundwater high is maintained by rainfall recharge to the aquifer, regional flow into the area, and the pool upstream of the dam. The groundwater high is consistently observed in monitoring well W42, immediately west of the Erection Bay, and in well W40, north and east of the bay, where an elevated water table is routinely measured. The groundwater high causes a slight southeasterly direction of flow through the Erection Bay source area, before a more south/southwesterly flow develops downgradient in the Storage Yard Area.

To simulate the observed flow, a combination of constant head and river nodes were required in the model (Figure 3-6). River nodes were designated along the western boundary to simulate the Rock River and the backwater areas west of the Erection Bay. The heads assigned to the river nodes were based on average elevations from staff gages reported in the RI. The river bed elevations were designated to maintain a constant 8-foot river depth along the length of the river. The leakage factor assigned to the river bed was taken from the Removal Action Design Report (Montgomery Watson 1996a), and determined by model calibration runs.

Constant head nodes were required to simulate the persistent groundwater high/divide located north and west of the Erection Bay. Along the east and south boundaries of the model area, constant heads nodes were required to simulate the observed flow field. These artificial conditions on the grid boundary did not significantly impact the predictive capabilities of the model in the area of interest around the Erection Bay. Head values used for the constant head nodes were taken from average water table elevations measured prior to ISCA operation (Table 3-1) and reported in the RI.

**Areal Recharge:** An infiltration rate of 4 inches per year was assumed based on an average percolation rate through non-sloping vegetated land in the Midwest region of the United States. This value was also used in design of the ISCA P&T system.

**Aquifer Type:** Unconfined.

## 3.4 Model Calibration

Calibration of the groundwater flow model was performed by adjusting hydraulic parameters, boundary conditions, and initial conditions within reasonable ranges to obtain a match between observed and simulated flow potentials. The Pre-ISCA Average Water Table Map (Figure 3-7) and the general flow configurations shown in Figure 3-5 were used as the basis for calibration. The final calibration run for the modeled area is shown in Figure 3-8. Calibration was evaluated through analysis of residuals. A residual is the difference between the observed and simulated head at a given location. Observed heads from eight water table well locations on the Average Water Table Map (Figure 3-7) were compared to model calculated heads by using a calibration routine in the FLOWPATH II software. The comparison is graphically presented on Figure 3-8. The mean error for the final calibration run was 0.04703 feet, and the root mean squared (RMS) error was 0.6692 feet. The low RMS value indicated that the model has been calibrated within reasonable tolerances.

The global water balance was also used to evaluate the validity of the simulation. A global water balance was calculated in FLOWPATH II after running the flow model. The water balance function computes all fluxes into and out of the model domain caused by pumping, recharge, leakage, and boundary conditions. To maintain continuity under steady-state conditions, the sum of all fluxes should be equal to zero. The validity of the converged model solution is best when the global water balance is small. Typically, the maximum acceptable water error balance should be less than 1% to 3%. For the final calibration run, the total mass balance error was 0.021118 % (Figure 3-8).

## 3.5 Sensitivity Analysis

Sensitivity analysis was used in the calibration process to identify those parameters that are the most important to model reliability. The purpose of the sensitivity analysis was to identify the uncertainty in the calibrated model caused by uncertainty in the estimates of aquifer parameters and other inputs. The parameters selected were the hydraulic conductivity, rainfall recharge, and river bed leakage.

The sensitivity analysis for hydraulic conductivity (increased one order of magnitude and decreased one-half order of magnitude) was performed for Zone 1, where the mass of contaminants requiring cleanup occur. Increasing the hydraulic conductivity value one order of magnitude in Zone 1 resulted in minor deviations from observed groundwater levels, but an increase in the RMS value of approximately 16% and a slightly greater total water balance error. Decreasing the hydraulic conductivity in this zone resulted in groundwater levels significantly different than observed conditions and an RMS value approximately 39% higher than the calibrated value. This indicated that the actual area-averaged conductivity in Zone 1 could be slightly higher, but is unlikely to be lower than the value used in the model. However, the calibrated model value provided a reasonable balance of residuals, RMS error, and water balance error values.

The sensitivity analysis for increasing recharge resulted in flooding the system and calculated heads that did not reflect observed groundwater levels. Therefore, it is unlikely that an increased rainfall recharge scenario is present. Reduction of rainfall recharge by one-half order of magnitude resulted in negligible differences, indicating that minor fluctuations in seasonal recharge would have limited impact on the predictive abilities of the model.

Increasing or decreasing the river bed leakage value within the selected range of values had little to no effect on the model simulations.

## 3.6 Evaluation of Existing ISCA P&T System at Erection Bay Source Area

To evaluate the effectiveness of the existing P&T system in the Erection Bay source area, extraction wells EW01 and EW02 were incorporated into the calibrated model. Figure 3-9 shows the approximate capture zones for PCE that have developed around EW01 and EW02 since the ISCA was implemented in July 1996. The pumping rate for EW01, 10 gallons per minute (gpm), was based on rates recorded during weekly inspections. This rate was time-averaged to take into account the pulsed-pumping scheme (daily 10 to 15 gpm for 20 hours, followed by 4 hours down) and significantly longer periods when EW01 was down due to O&M issues. The rate for EW02, 15 gpm, was similarly time-averaged to account for fluctuations in recorded pumping rates, and down periods. Extraction well EW02 is not pulse-pumped.

The capture zones for the two extraction wells illustrate several issues that lead to low system effectiveness:

- Low pumping rates lead to limited capture zones. Complete capture of the Erection Bay source area plume has likely not been achieved, even after approximately 10 years of pumping. Low hydraulic conductivity around EW01 and unanticipated down time due to property transfer and O&M issues are contributing factors. The cause of low rates in EW02 (designed to pump 25 gpm) is unknown, but is being investigated by the O&M contractor (Bodine Environmental Services).
- Inadequate location of EW01. The original objective for the ISCA system was to initiate contaminant mass removal while containing groundwater within the Beloit property boundaries. Now that the Erection Bay source area plume has been shown to be larger than anticipated and oriented in a south-easterly direction, the location of EW01 is inadequate for efficient plume removal.
- Extraction well EW01, placed at the contaminant area perimeter, withdraws a large volume of clean groundwater from beyond the plume via flowlines that do not flush the contaminated zone. While operating, EW01 withdraws less than half of its incoming water from a contaminated zone (Zone A), likely resulting in an effective withdrawal rate of only 5 gpm. Similarly, well EW02 withdraws groundwater from areas outside the contaminated zone, thereby reducing its effective withdrawal rate to approximately 10 gpm.

Restoration of the aquifer requires that sufficient groundwater be flushed through the contaminated zone to remove both existing dissolved contaminants and those that will continue to desorb from porous media and/or diffuse from low-permeability zones. To further asses the existing P&T system in the Erection Bay source area, the times required to pump one pore volume (PV) of groundwater from the source area contaminated zone, and estimates of the number of PVs needed for cleanup were calculated (EPA/540/S-97/504). Table 3-1 provides the estimated pore volumes required to flush the contaminated zones and the minimum time required to reach cleanup (e.g., MCL for PCE [5 μg/L]), given the effective withdrawal rates of 5 gpm for EW01 and 10 gpm for EW02. From this table, it is obvious that the time required under current conditions may be extensive, ranging up to 60 years. It should be noted that this analysis may generally oversimplify the complex site conditions. However, it provides an indication that improvements to the current system are required for the Erection Bay area.

A particle tracking routine in the FLOWPATH II software was used to evaluate capture of PCE under steady-state (maximum time) conditions. In Figure 3-10, particles were placed at the perimeter of the outermost contaminated zone (Zone C), and allowed to travel under current pumping conditions. The results of this model run suggest that some portions of the contaminated zone are never captured by extraction well EW01 or EW02. Although these particles are likely captured by well EW03, located further downgradient of the Erection Bay (not part of the model), additional time is required for this travel to occur and ultimately contributes to prolonging the remediation time frame.

## 3.7 ISCA Extension into the Erection Bay Source Area

The calibrated model was used to examine alternative extraction well schemes in the Erection Bay area. The FLOWPATH II model allows the graphical addition and deletion of pumping and observation wells and the ability to edit their location, pumping rates, and observed head values. By trial-and-error adjustment of the number of extraction wells, their location, and various trial pumping rates, an optimum configuration of extraction wells in the Erection Bay source area was determined. Multiple simulations were run with the objective of maximizing pore volumes pulled through the system (maximize pumping rates), minimizing stagnation zones between extraction wells, and achieving quick capture of the contaminant mass.

A combined source control, mid-plume, and downgradient pumping scheme was determined to be optimal in reducing the flow path and travel times of contaminants to extraction wells. Under this configuration, extraction well EW01 was no longer utilized, but a replacement well, EW05-NEW, was positioned at the opposite corner of the Erection Bay, closer to the center of center of contaminant mass in the most contaminated zone (Zone A). Two new extraction wells, EW06-

NEW and EW07-NEW, were positioned in roughly a line extending from the southeast corner of the Erection Bay to extraction well EW02. The location of the proposed new wells and the PCE capture zones anticipated to develop after 10 years of pumping are shown in Figure 3-11. To maximize the pumping rates achievable at each new extraction well, it was assumed that pneumatic fracturing of the unconsolidated aquifer would be performed at each extraction well borehole, prior to installation of the well. This was simulated in the model by incorporating a zone of higher conductivity around each well. These higher conductivity zones had a radius of approximately 25 feet and a conductivity value one order of magnitude greater than the surrounding formation (i.e., 20 feet/day compared to 2 feet/day). Maximum achievable pumping rates determined in the model were 15 to 16 gpm for wells EW05-NEW, EW06-NEW, and EW07-NEW, and 25 gpm for existing well EW02.

The estimated pore volumes required to flush contaminated zones and the minimum time required to reach cleanup (i.e., MCLs) were calculated using the modeled extended extraction system. Table 3-2 provides these results. Due to the increased pumping rates of the new extraction wells and the increased conductivities anticipated from pneumatic fracturing of the formation, the estimated minimum time for required pore volume removal prior to reaching cleanup was calculated to be 75% less than existing conditions, with EW01 and EW02 pumping at their current rates.

Finally, the calibrated model was used to place PCE particles at the perimeter of the contaminated zone (Zone C) to evaluate capture under steady-state conditions. Figure 3-12 shows the results of this simulation. Capture of PCE from the far boundary of Zone C is achieved within 10 to 12 years, with complete capture of the more contaminated Zones A and B achieved in 1 to 2 years.

Based on this modeling, it is proposed that the design for the extraction system extension include three new extraction wells, rehabilitation of well EW02 to increase its pumping rate, and shutdown of EW01. Abandonment of EW01 is not recommended initially, however; this may be required after the extended extraction system becomes operational. To monitor the effectiveness of the extension system, three to four additional monitoring wells will be required within the Erection Bay area. Existing monitoring wells, including wells W23 and W23B, will continue to be used to monitor the new system, as well as all other monitoring wells currently being sampled under the ISCA Quarterly Sampling efforts. Within a few years' time, it is anticipated that a measurable downward trend in VOC concentrations would be observed in Erection Bay monitoring wells, and a remediation end-point could be estimated from the trend analysis. Performance of the new extraction system would also be subject to 5-year review, thereby providing an opportunity to make additional system adjustments or enhancements to the overall remedy.

# Table 3-1
## Estimated Pore Volumes Required to Flush Contaminated Zones with Existing ISCA System Erection Bay Source Area, Beloit Corporation NPL Site, Rockton, Illinois

| Zone | Assumed Average Concentration In Zone (Cwo) (µg/L) | Radius of Circular Zone (ft) | Surface Area (sq ft) | Top of Aquifer (amsl) | Bottom of Aquifer (amsl) | Thickness of Saturated Zone (ft) | Porosity | Pore Volume (PV) [1] (cu ft) | Pore Volume (PV) [1] (gallon) | Approximate Effective Withdrawal Rate In Zone [2] (gpm) | Time for One PV Removal (years) | Minimum Number of Pore Volumes Required to Reach MCL (PCE) [3] (PVs) | Minimum Time to Reach MCL (years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1500 | 100 | 62,800 | 726 | 680 | 46 | 0.2 | 577,760 | 4,321,945 | 5 | 1.6 | 10.7 | 17.5 |
| B | 500 | 225 | 255,125 | 726 | 680 | 46 | 0.2 | 2,347,150 | 17,557,903 | 5 | 6.7 | 8.6 | 57.5 |
| C | 50 | 380 | 588,907 | 726 | 680 | 46 | 0.2 | 5,417,944 | 40,529,041 | 10 | 7.7 | 4.3 | 33.2 |
| Total Plume Area [4] | 277 | 380 | 906,832 | 726 | 680 | 46 | 0.2 | 8,342,854 | 62,408,889 | 15 | 7.9 | 7.5 | 59.3 |

Notes:

1. Pore Volume (EPA/540/S-97/504):

**PV = BnA**

where: B = Thickness of plume (assume equal to saturated thickness)
n = Porosity
A = Area of the plume

2. Zone A Withdrawal Rate: Time-averaged 10 gpm from EW01. Assumes approximately 5 gpm withdrawn from Zone A with remainder from upgradient.
Zone B Withdrawal Rate: Assumes 5 gpm as a result of pumping EW01 in Zone A.
Zone C Withdrawal Rate: Assumes 10 gpm contributed by EW02.

3. Number of Pore Volumes required to reach cleanup (EPA/540/S-97/504):

**No. of PVs = -R ln (Cwt / Cwo)**

where: Contaminant = PCE
Retardation Factor, (R) = 4.3
Cleanup concentration (Cwt), i.e., MCL = 5
Initial Aqueous Concentration (Cwo) = See table above.

4. Weighted Average Concentration:

| | Volume (gal) | % of Total Vol. | Conc. In Zone |
|---|---|---|---|
| Zone A | 4,321,945 | 6.93% | 1,500 |
| Zone B | 17,557,903 | 28.13% | 500 |
| Zone C | 40,529,041 | 64.94% | 50 |
| Total | 62,408,889 | 100.00% | |
| | | Weighted Ave. = | 277 |

# Table 3-2
## Estimated Pore Volumes Required to Flush Contaminated Zones with Extended Extraction System
## Erection Bay Source Area,
## Beloit Corporation NPL Site, Rockton, Illinois

| Zone | Assumed Concentration in Zone (Cwo) (µg/L) | Radius of Circular Zone (ft) | Surface Area (sq ft) | Top of Aquifer (amsl) | Bottom of Aquifer (amsl) | Thickness of Saturated Zone (ft) | Porosity | Pore Volume (PV)[1] (cu ft) | Pore Volume (PV)[1] (gallon) | Approximate Effective Withdrawal Rate in Zone[2] (gpm) | Time for One PV Removal (years) | Minimum Number of Pore Volumes Required to Reach MCL (PCE)[3] (PVs) | Minimum Time to Reach MCL (years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1500 | 100 | 62,800 | 726 | 680 | 46 | 0.2 | 577,760 | 4,321,945 | 23.5 | 0.3 | 10.7 | 3.7 |
| B | 500 | 225 | 255,125 | 726 | 680 | 46 | 0.2 | 2,347,150 | 17,557,903 | 30 | 1.1 | 8.6 | 9.6 |
| C | 50 | 380 | 588,907 | 726 | 680 | 46 | 0.2 | 5,417,944 | 40,529,041 | 42 | 1.8 | 4.3 | 7.9 |
| Total Plume Area[4] | 277 | 380 | 906,832 | 726 | 680 | 46 | 0.2 | 8,342,854 | 62,408,889 | 59 | 2.0 | 7.5 | 15.2 |

Notes:

1. Pore Volume (EPA/540/S-97/504):

**PV = BnA**

where: B = Thickness of plume (assume equal to saturated thickness)
n = Porosity
A = Area of the plume

2. Zone A Withdrawal Rate: Approximately 16 gpm from EW05-NEW and 7.5 gpm from EW06-NEW
Zone B Withdrawal Rate: Approximately 7.5 gpm from EW06-NEW and 7.5 gpm from EW07-NEW
Zone C Withdrawal Rate: Approximetely 7.5 gpm from EW07-NEW and 12.5 from EW02

3. Number of Pore Volumes required to reach cleanup (EPA/540/S-97/504):

**No. of PVs = -R ln (Cwt / Cwo)**

where: Contaminant = PCE
Retardation Factor, (R) = 4.3 http://www.epa.gov/Athens/learn2model/part-two/onsite/retard.htm
Cleanup concentration (Cwt), i.e., MCL = 5
Initial Aqueous Concentration (Cwo) = See table above.

4. Weighted Average Concentration:

| | Volume (gal) | % of Total Vol. | Conc. In Zone |
|---|---|---|---|
| Zone A | 4,321,945 | 6.93% | 1,500 |
| Zone B | 17,557,903 | 28.13% | 500 |
| Zone C | 40,529,041 | 64.94% | 50 |
| Total | 62,408,889 | 100.00% | |
| | | Weighted Ave. = | 277 |

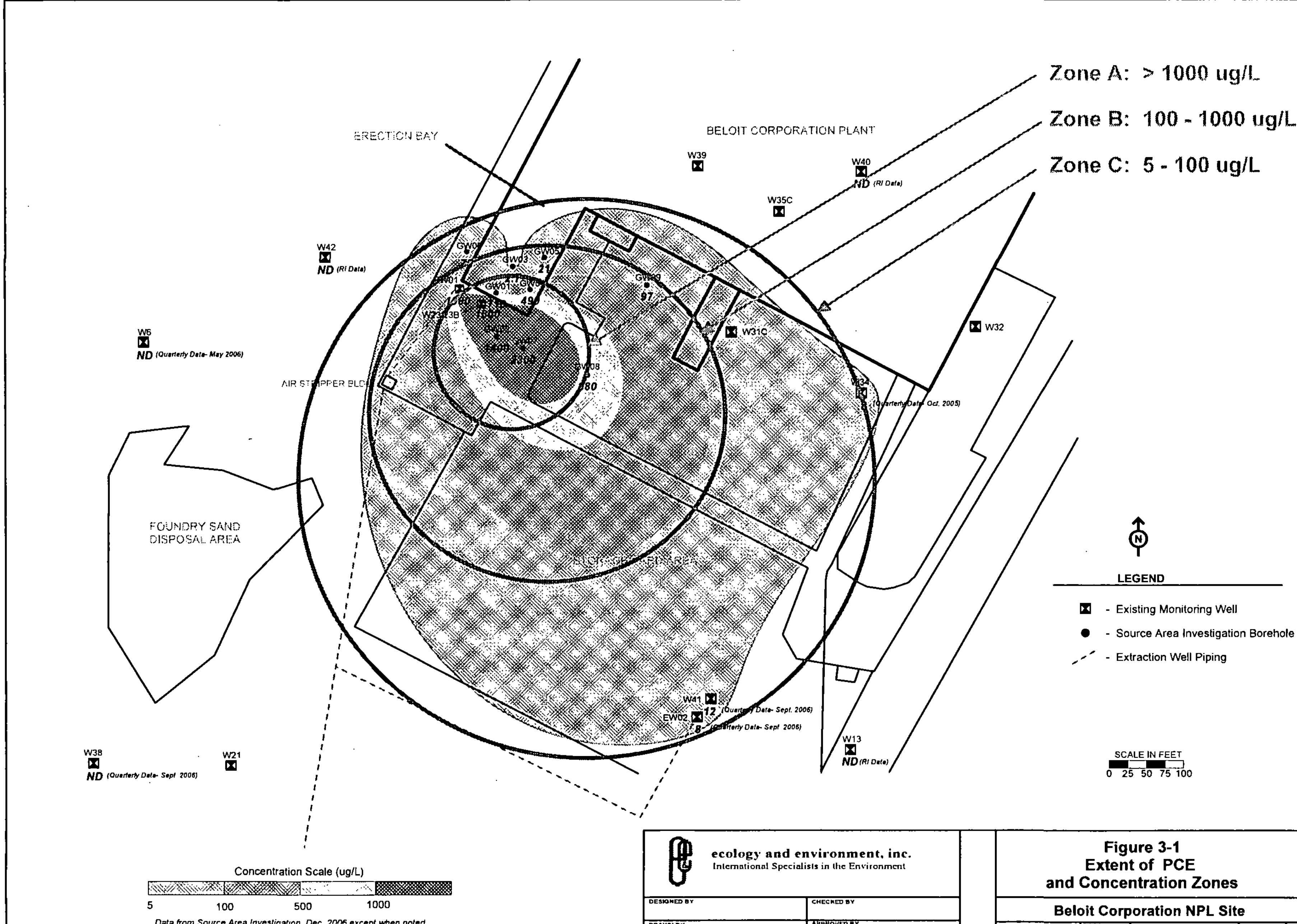


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**Figure 3-1**
**Extent of PCE and Concentration Zones**

**Beloit Corporation NPL Site**

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|---|---|
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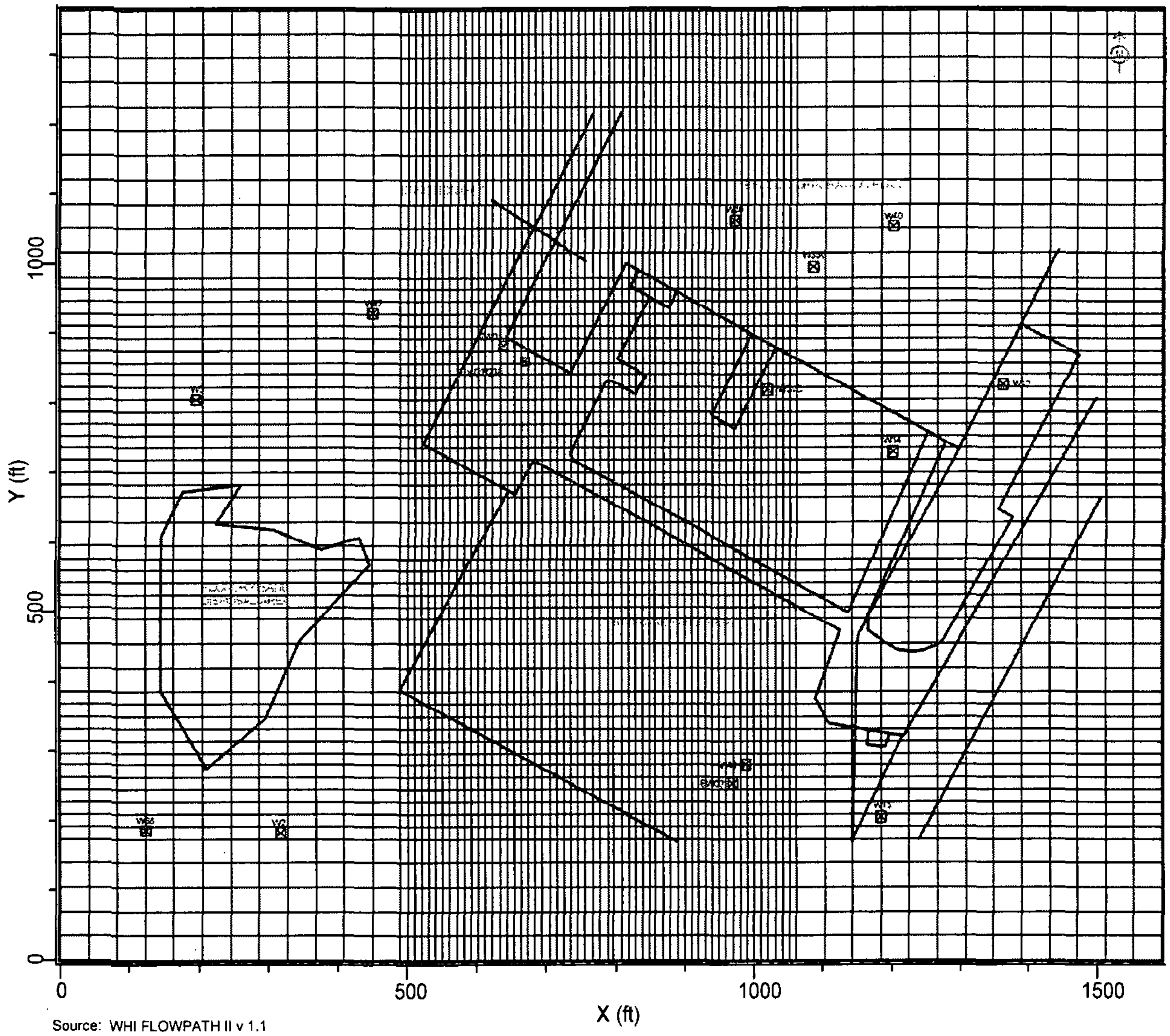
| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
|---|---|---|---|---|
| See Figure | 2/2/2007 | | | 0 |




Source: WHI FLOWPATH II v 1.1

No. Columns: 83 No. Rows: 58

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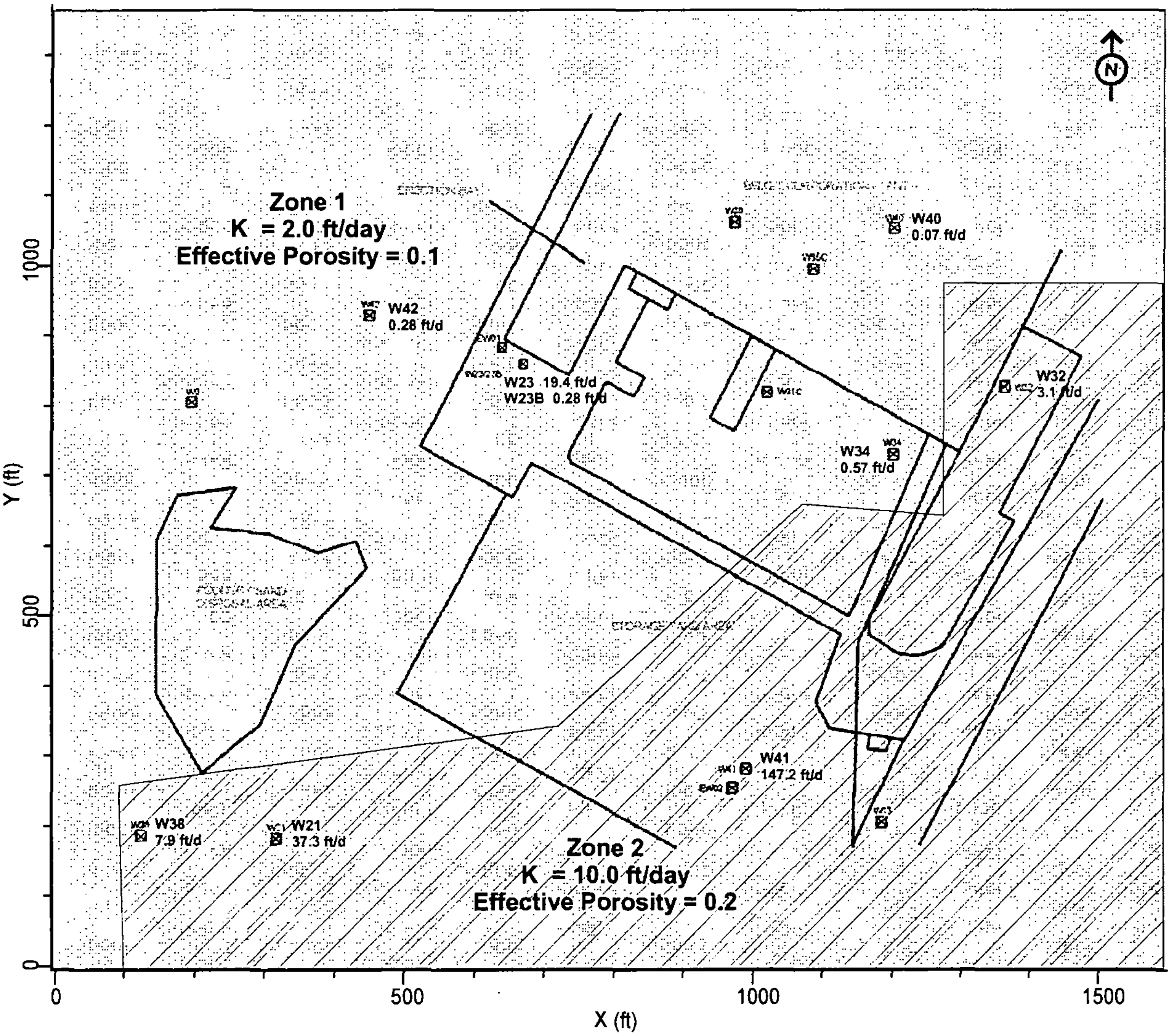
**Figure 3-2**
**Model Grid**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO | DRAWING NO | REV. |
|---|---|---|---|---|




Source: WHI FLOWPATH II v 1.1

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**Figure 3-3**
**Model Conductivity and Porosity Zones**

Beloit Corp. NPL Site, Rockton, Illinois

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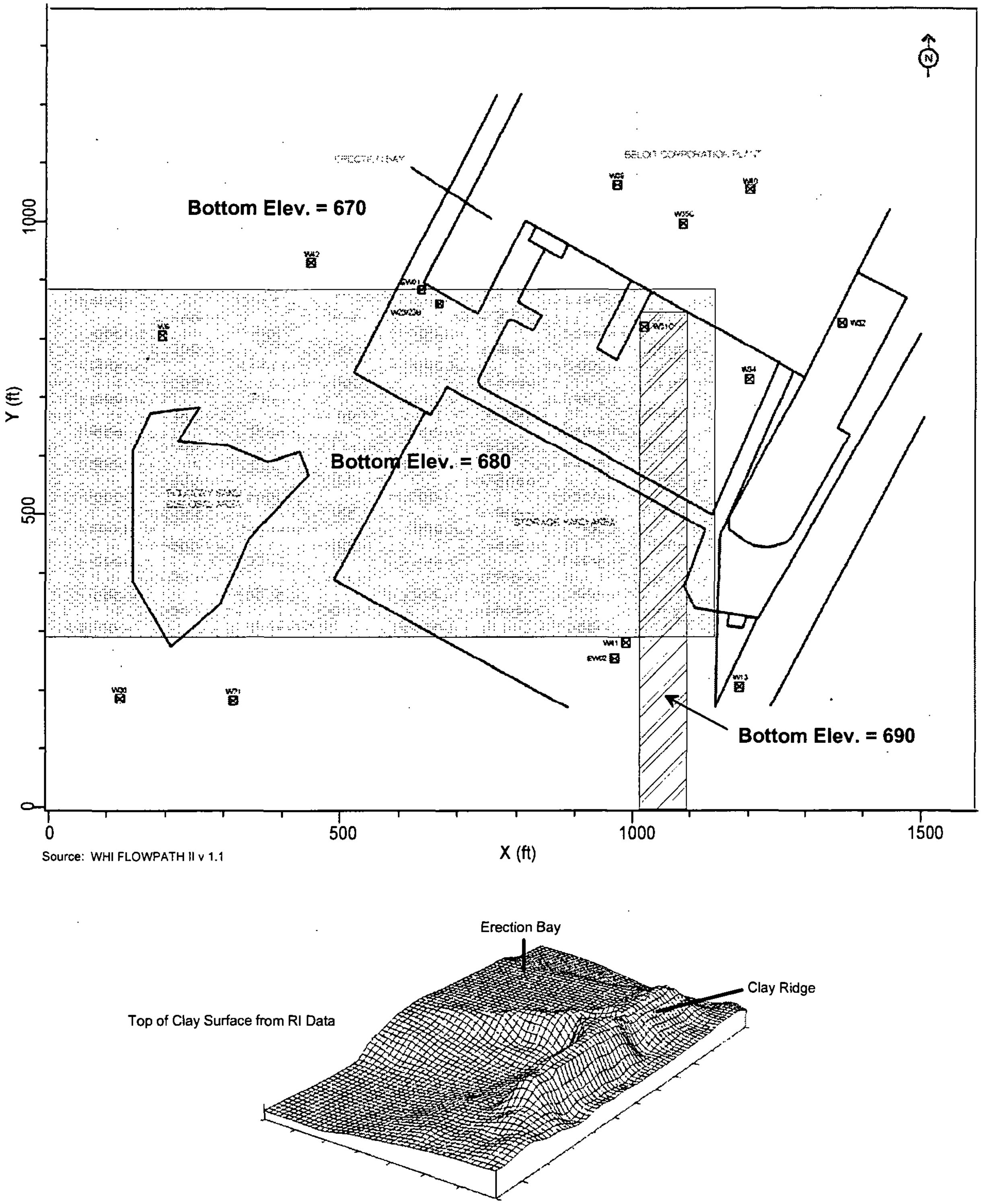


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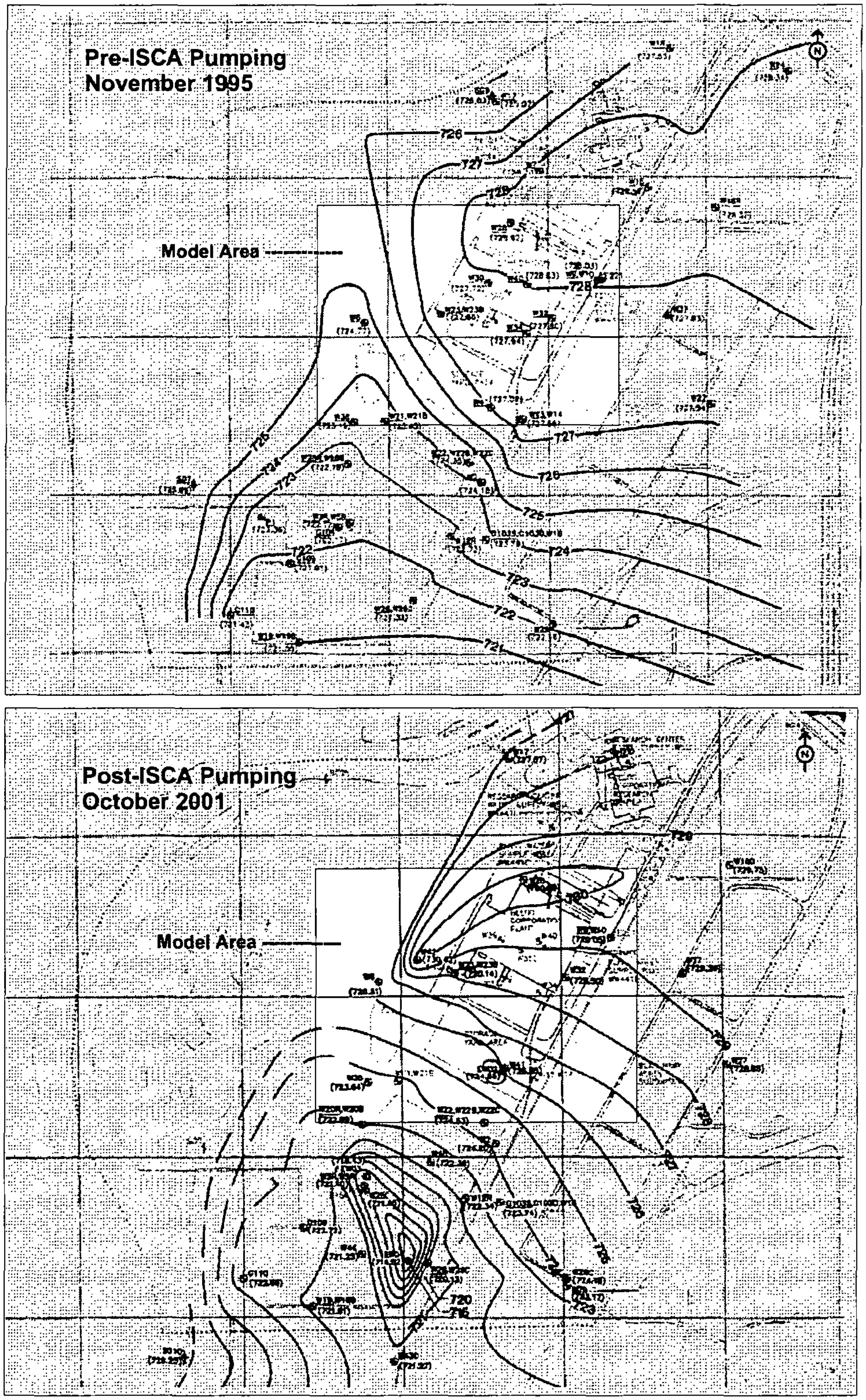
**Figure 3-4**
**Model Aquifer Bottom Elevations**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO | DRAWING NO. | REV. |
|---|---|---|---|---|




Map Sources:
November 1995 Map - RI/FS Technical Memorandum 3, Sept. 1996, Montgomery Watson.

October 2001 Map - Quarterly ISCA Report, August -October 2001, dated January 2002, Montgomery Watson Harza.

Scale: See original reports.

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**Figure 3-5**
**Typical Water Table Contours**
**Pre- and Post ISCA**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO | DRAWING NO | REV. |
|---|---|---|---|---|

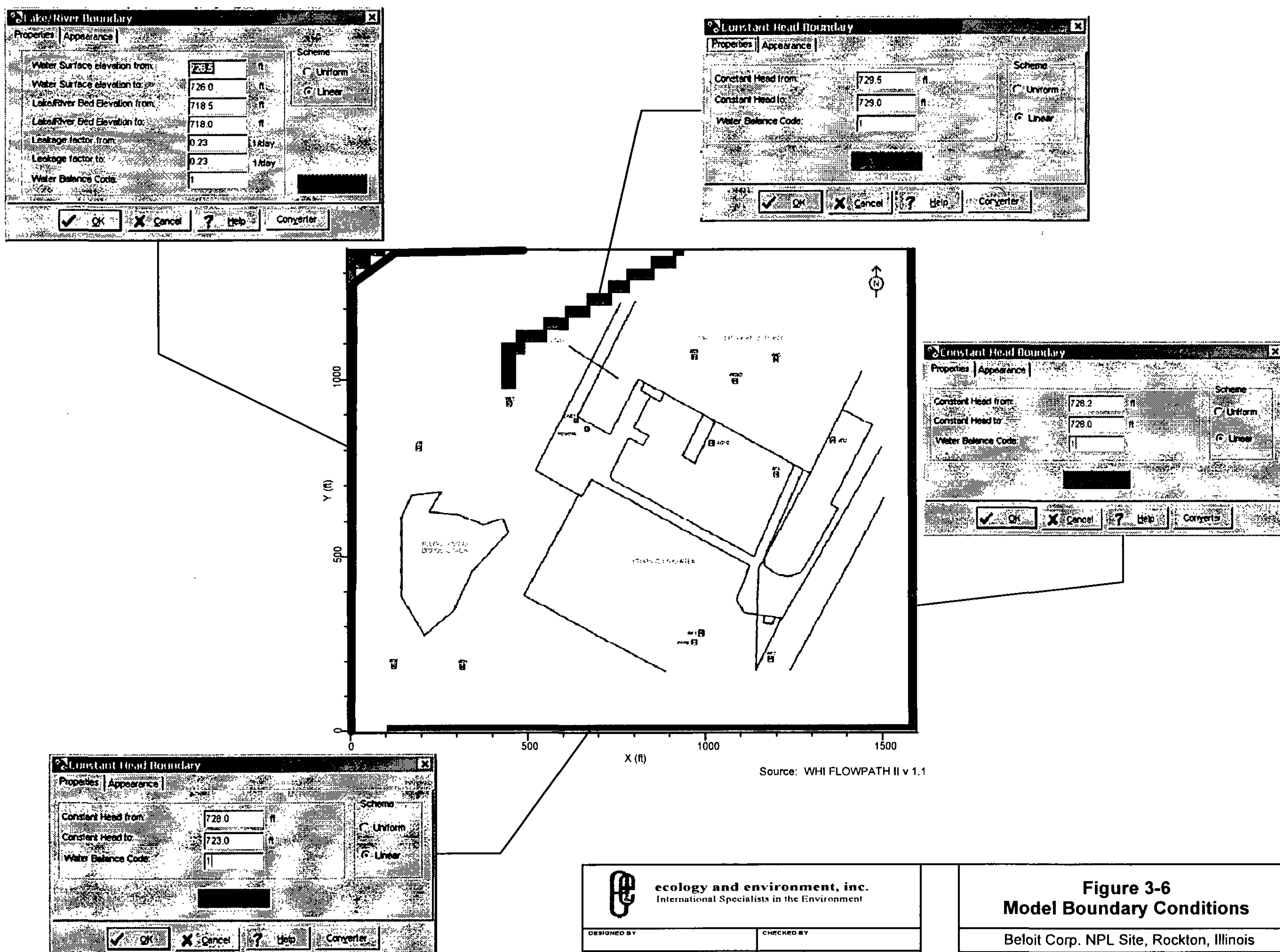


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**Figure 3-6**
**Model Boundary Conditions**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
|---|---|---|---|---|
| | | | | |

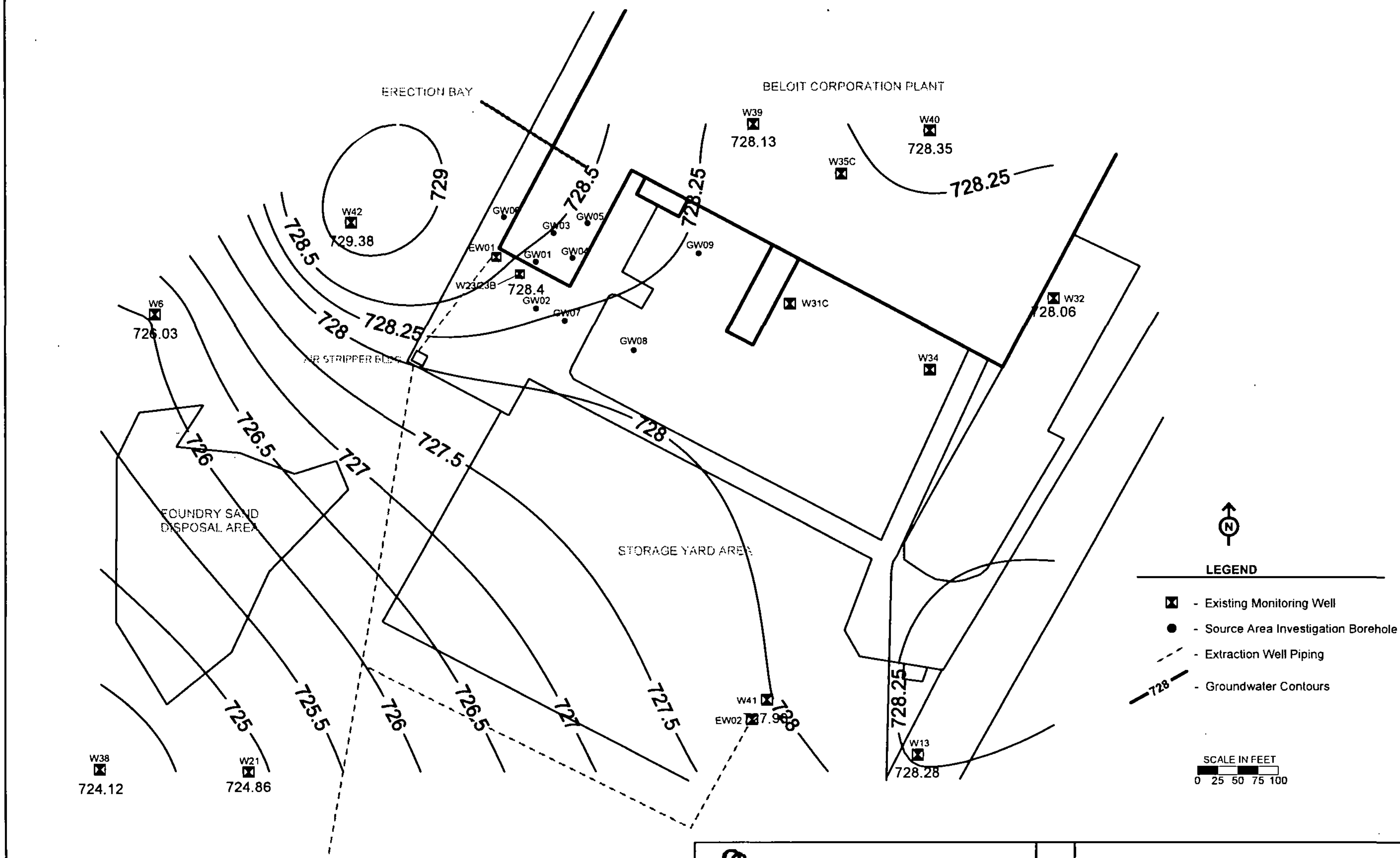


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**Figure 3-7**
**Pre-ISCA Average Water Table Map**

**Beloit Corporation NPL Site**

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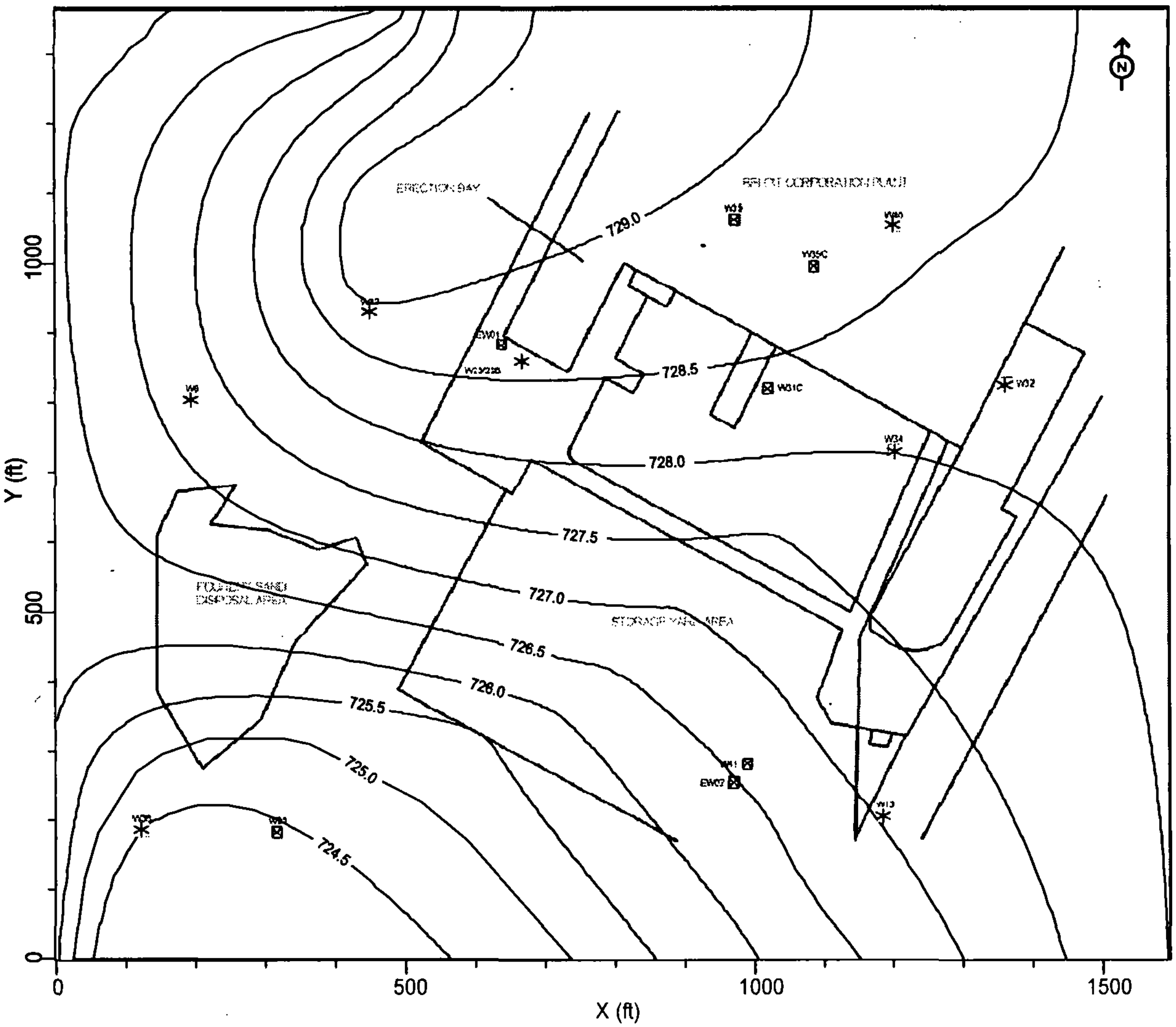
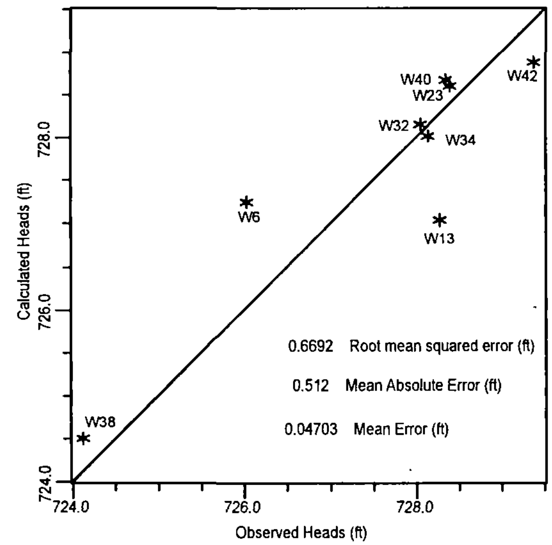
| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
|---|---|---|---|---|
| See Figure | 2/2/2007 | | | 0 |




Source: WHI FLOWPATH II v 1.1




Flow Model for DataSet =
C:\Program Files\WHI\Beloit\ERECTION BAY
Calculating hydraulic heads. Solver : PCG, unconfined aquifers.
Outer Iteration #1
Maximum head correction : 0.0000 ( 0.0000 ft)
occurred at node H[0,0] = 0.0000
Outer Iteration #2
Maximum head correction : 0.0088 ( -0.0569 ft)
occurred at node H[50,43] = 728.7011
Outer Iteration #3
Maximum head correction : 0.0000 ( -0.0000 ft)
occurred at node H[50,43] = 728.7011

Global water balance [ft^3/d] :

| | |
|---|---|
| 1314.9771 | IN const. head nodes |
| -2904.6760 | OUT const. head nodes |
| 0.0000 | IN flux nodes |
| 0.0000 | OUT flux nodes |
| 487.7333 | IN river nodes |
| -808.7722 | OUT river nodes |
| 0.0000 | IN Drain nodes |
| 0.0000 | OUT Drain nodes |
| 0.0000 | IN injection wells |
| 0.0000 | OUT pumping wells |
| 1911.5221 | net aquifer recharge |
| 0.0000 | IN leakage from below |
| 0.0000 | OUT leakage from below |
| 0.0000 | IN leakage from above |
| 0.0000 | OUT leakage from above |
| 0.021118% | total mass balance error |

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**Figure 3-8**
**Calibrated Groundwater Flow Map**

**Beloit Corporation NPL Site**

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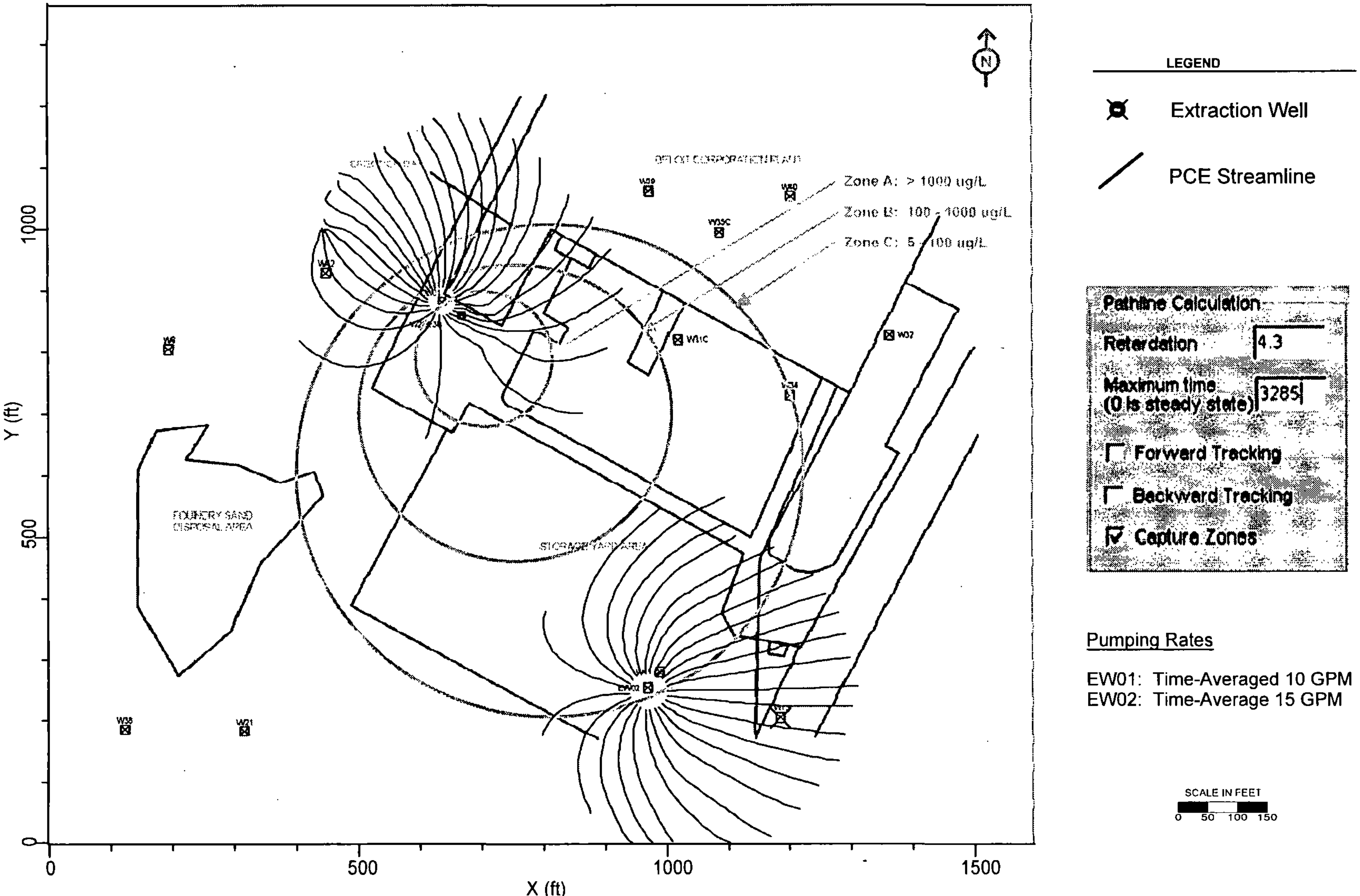


Pumping Rates

EW01: Time-Averaged 10 GPM
EW02: Time-Average 15 GPM

Source: WHI FLOWPATH II v 1.1

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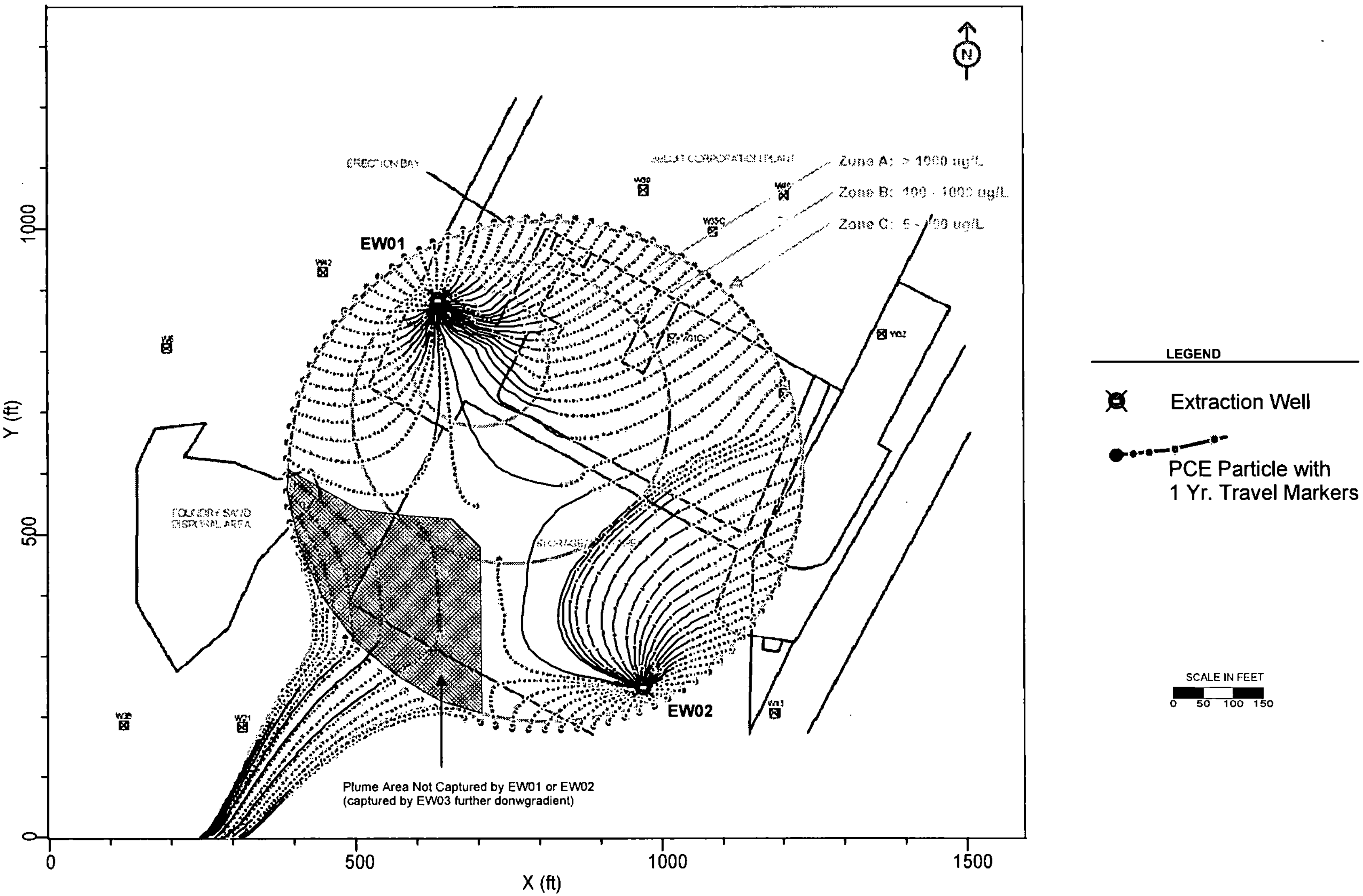
**Figure 3-9**
**9 Yr. PCE Capture Zone, ISCA Wells EW01 and EW02**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
|---|---|---|---|---|




Source: WHI FLOWPATH II v 1.1

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**Figure 3-10**
**PCE Particle Capture Map, Existing ISCA System**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO. | DRAWING NO | REV. |
| --- | --- | --- | --- | --- |

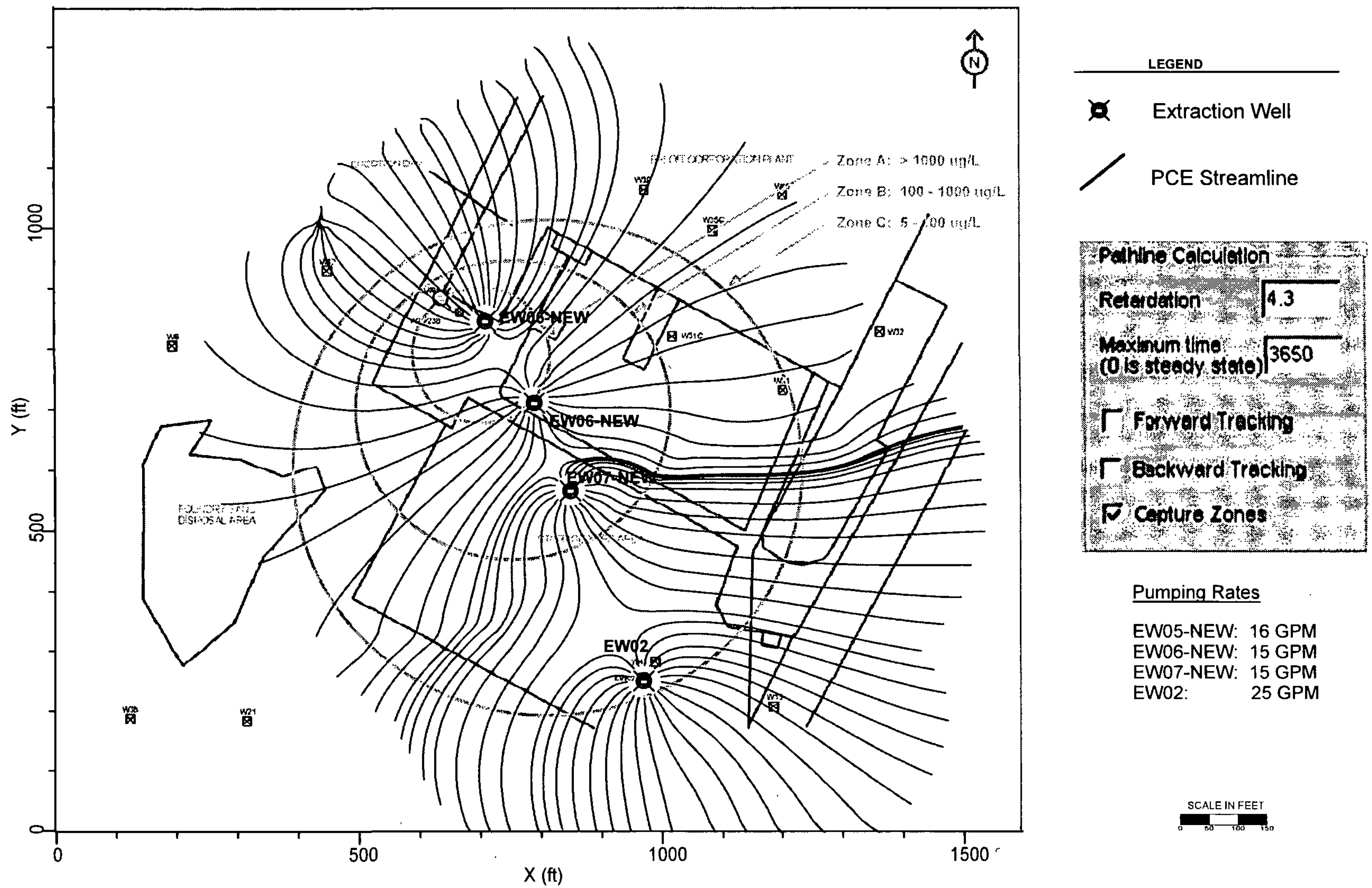


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**Figure 3-11**
**10 Yr. PCE Capture Zones, Extended Extraction System**

Beloit Corp. NPL Site, Rockton, Illinois

| DESIGNED BY | CHECKED BY |
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| SCALE | DATE | FILE NO. | DRAWING NO. | REV. |
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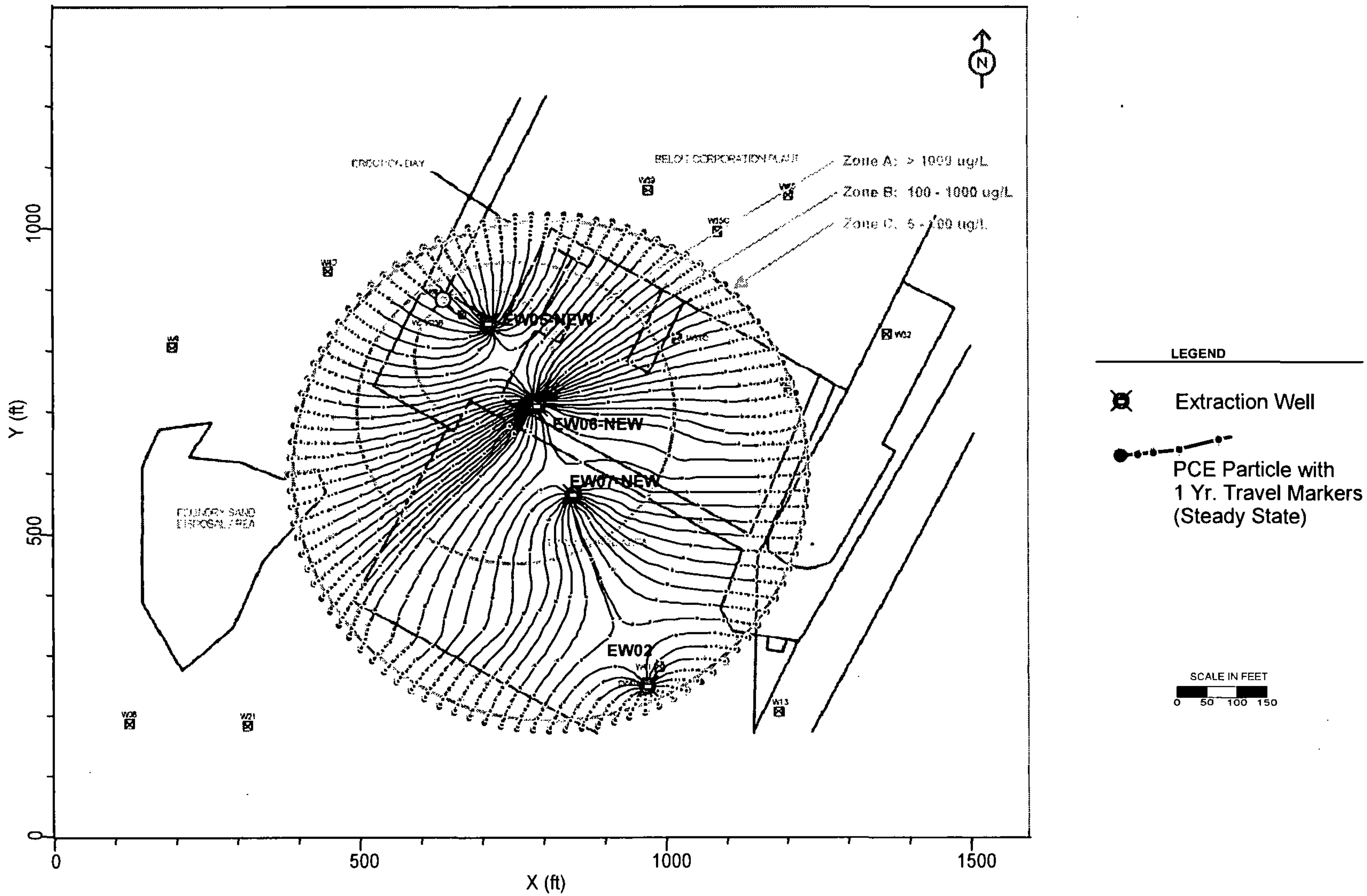
Source: WHI FLOWPATH II v 1.1




Source: WHI FLOWPATH II v 1.1

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**Figure 3-12**
**PCE Particle Capture Map, Extended Extraction System**

Beloit Corp. NPL Site, Rockton, Illinois

| SCALE | DATE | FILE NO. | DRAWING NO | REV. |
|---|---|---|---|---|

# 4 ISCA Engineering Evaluation

On March 26 and 27, 2007, EEEI performed an ISCA Engineering Evaluation concurrently with the quarterly groundwater sampling event conducted by Illinois EPA's Corrective Action Contractor (CAC) and O&M Contractor, BES. During the ISCA Engineering Evaluation (ISCA EE), the system components were inventoried and layouts of equipment, electrical, and control systems were evaluated.

As stated in Section 2 of this report, the RD WP included performing a pilot test to determine dosage of in situ chemical oxidation injections. However, because chemical oxidation was determined to be impractical, installation of three extraction wells within the source area is being implemented with well placement as described in Section 3. Therefore, the ISCA EE was also used to determine how extraction well force main and electrical connections to the existing pump-and-treat system would be accomplished.

## 4.1 ISCA Engineering Evaluation Findings

The RD WP stated that at a minimum EEEI would perform the following tasks as part of the ISCA EE:

1. Evaluate the main electrical feed from the former Beloit Corporation Plant to the treatment building to determine whether proper voltage and/or amperage is present;
2. Evaluate the Blancett flow meters located in the influent lines;
3. Evaluate the level control for the air stripper sump section;
4. Reevaluate the discharge pump to determine whether it is still drawing excess amperage on one leg of its three-phase service;
5. Correct the safety issue of the open leak detection sump;
6. Evaluate access to the treatment building telemetry system;
7. Address problems with the effluent line; and
8. Evaluate the condition of all monitoring wells.

The main electrical feed from the former Beloit Corporation Plant to the treatment building was repaired by a licensed electrician between the time that the RD WP was prepared, and the ISCA EE was performed. BES oversaw the repair of the electrical feed. EEEI removed the cover of the main feed electrical panel to check whether proper voltage was present. EEEI found 490 to 495 volts alternating current (VAC) across the three legs of the three-phase system. Based on this finding, the incoming feed has less than a 1% voltage unbalance and less than 10% overvoltage of the stated transfer pump motor nameplate voltage, all within acceptable ranges for proper motor operation. Because the system was shut down during testing, blower voltage and amperage to the motor could not be tested. Additionally, the transfer pump motor could not be checked to determine whether it is still drawing excess amperage on one leg of its three-phase service because it had stopped working. A new motor was ordered and installed upon arrival. BES oversaw the installation of the new motor. However, while BES was planning to have the feed to the transfer pump checked again, it appears that all electrical feed problems to the pump-and-treat system had been resolved.

When the RD WP was written, it was thought that Blancett flow meters were located on the influent lines. Upon visiting the site, however, EEEI found that the lone Blancett flow meter is located on the effluent line. The influent lines contain direct-read flow totalizers only. The O&M technician records the total gallons pumped to date and estimates a flow rate from each extraction well using the totalizer readings. The Blancett flow meter on the effluent line has a digital readout displaying the current flow rate and amount of effluent to date. The weekly flow meter reading does not match the sum of totals as displayed by the influent line totalizers, so it is not used by the O&M technician. Total effluent is reported as the sum of all influent line totalizers.

The level control for the air stripper sump section has been repaired since the writing of the RD WP and is now operating correctly. The high level and high-high level floats had apparently been sticking and allowing water to contact the electronics.

During the ISCA EE, the open leak detection sump was measured so that final plans and specifications can specify a sump cover. The sump is 11.25 inches in diameter. The level control within the sump is not operational, and an open electric conduit box for the control circuitry exists. A check of the telemetry system was made. The telemetry system operates over a phone line and could be operational if phone service was obtained for the building. An existing phone line was traced exiting from the pump-and-treat building; however, based on the setup of the pump-and-treat system, EEEI does not feel that an autodialer is necessary. The autodialer is the only way that currently exists to obtain motor run times for the system.

The condition of all monitoring wells was recorded by EEEI during the SAI. The findings of the SAI monitoring well evaluation were compared to notes obtained from BES following quarterly water level readings and groundwater sampling for the first quarter of 2007 to produce Table 4-1. The findings of the SAI matched BES's results, except for well W2, which has been damaged since the SAI. W2 was damaged when one of the steel beams staged next to this well by Reload, Inc., fell against the well. A complete listing of all wells was presented in the SAI Technical Memorandum (E & E 2007). The final design will include plans and specifications for abandonment and/or repair of those monitoring wells listed as damaged.

Problems with the effluent line are being addressed separately from this design. Effluent line modification plans and a statement of work prepared by EEEI are being implemented by BES as part of the ongoing system O&M. Effluent line modifications entail installing manholes at key locations so that the effluent line can be repaired and cleaned as necessary to correct flow and allow future maintenance.

Sections 4.2 and 4.3 present additional information gathered about the current arrangement of the ISCA pump-and-treat system. The information was collected during the ISCA EE and from the current Beloit Corporation O&M Manual.

## 4.2 Existing Groundwater Treatment System

The existing ISCA pump-and-treat system consists of four extraction wells (EW01, EW02, EW03, EW04), which pump contaminated groundwater to the on-site treatment building. EW04 has two groundwater extraction pumps installed, which are designated as EW04 pump 1 (EW04-1) and EW04 pump 2 (EW04-2). The treatment building contains an air stripper that removes VOCs from contaminated groundwater. Treated groundwater is then discharged to the former Beloit Corporation Research and Development manhole via an underground piping run, with the effluent ultimately discharging to the Rock River.

The air stripper consists of a packed, forced draft air stripping column designed for VOC removal. Contaminated groundwater enters near the top of the column, flows downward across the packing, and is collected in a sump at the column base. The packing consists of polypropylene ellipsoids that are violently lifted by the forced draft air. Air is introduced to the system near the column base by a belt-driven blower. The blower is fed by outside air and vented through the top of the column. A demister prevents water from leaving the top of the column. Treated water is discharged in batches via a 450-gallon per minute transfer pump.

The air stripper is a Turbostripper model manufactured by Diversified Remediation Controls Incorporated. Based on Discharge Monitoring Reports (DMRs) recently submitted to the Illinois EPA Compliance Assurance Section by the

O&M contractor, BES, the system is effectively treating extracted groundwater at current flow rate, air volume, and influent concentrations.

The ISCA pump-and-treat system is powered from an underground electrical feed from the former Beloit Corporation building, now managed and run by Reload, Inc. The feed consists of three-phase, 480 VAC, which enters through the floor of treatment building into electrical busway. The busway contains all electric wiring between the 480-volt (V) panel, 240V panel, and control panel. The 480V panel has circuit breakers for all five well pumps, the 25-kilovolt-ampere (kVA) transformer, transfer pump, air stripper blower, and building heater. The three additional wells being added to the system will also have wiring running through this panel. The 480V panel has 16 remaining twistout slots open; each well will require three twistout slots grouped together in order to be installed, which, based on the spacing in the panel, allows up to four additional wells to be installed. Therefore, an additional subpanel located off the 480V panel will not be required.

The 480V panel feeds the 25-kVA transformer that in turn feeds the 120V panel. The 120V panel has circuit breakers for the building exhaust fan, lights, receptacles, and control panel blower. There are several open twistouts, although none will be required for this design. The third panel contains all of the controls for system operation. The control panel has hand/off/auto (HOA) switches for the five well pumps, air stripper blower motor, transfer pump motor, and drain solenoid. Additional HOA switches will be required for each well pump added to the system, and these additions will be incorporated into the 95% Design Documents.

The system is controlled by an Allen-Bradley Modicon programmable logic controller (PLC). The PLC runs a program using the ProWorks NXT Lite software. A printout of the program was obtained during the ISCA EE. The program will require an upgrade to add the additional wells and associated control components to the system. The PLC has three input and output (I/O) modules consisting of two 24-volt direct current (VDC) input modules with 16 terminals per module and one 115-VAC output module with 16 terminals. There are seven spare input terminals. Each new well will require two input terminals, one for relaying that the HOA switch is in the Auto position requiring PLC control and one from the well pump giving its running status. Three wells will require six of the seven available inputs; therefore, the input module has the capacity for the intended system upgrades. The output module has eight spare terminals. Each well only requires one output terminal to relay stop and start commands, so adequate space is available. I/O modules will not need to be added, or upgraded to 32 terminal modules, to introduce three new extraction wells to the system.

The control panel contains the electric feed terminal blocks and motor starters for each of the five existing well pumps. There is no spare terminal block available for wiring hookups and only room for one additional motor starter within the control panel. Hookup of three additional extraction wells to the control panel will require a subpanel mounted adjacent to the existing control panel and connected with conduit/bus runs. Sixteen inches of space is present to the right of the panel for subpanel mounting.

After system evaluation, it has been determined that design of the system will require detailed electrical design calculations and drawings. EEEI will subcontract an Illinois-licensed professional electrical engineer to complete this portion of the design.

During the ISCA EE, EEEI reviewed Operations Logs that had been completed by the O&M contractor. These logs date back to the startup of the plant. Initial flow rate records from EW02 show the well producing at 30 to 35 gpm. This rate is followed by an abrupt change in which EW02 begins to produce flow at a reduced rate of 12 to 14 gpm, the rate at which it remains to this day. Although the flow rates of wells EW01, EW02, and EW03 have decreased from initial flow rates, EW02 has had the most noticeable decline in production. At the time this occurred, attempts were made to restore the original production rates from this well; however, EW02 has never produced at the rates originally seen.

Following the ISCA EE, EEEI performed initial pipe sizing calculations for the three new extraction well pumps. Since all of the force mains come together within a single manifold pipe, it was required to model all of the existing pumps together. When a single manifold exists, it is necessary for the pressure within all pipes to be nearly the same or else one pump will "step on" another. This means that one well can prevent another well from pumping because the pressure differential at the connections/interface is too great, and the well with the greatest pressure continues to pump. With moderate pressure differences, one well can restrict flow from another well without completely shutting down flow. It can be hypothesized that the fall in production for all wells is due to the effects following the addition of pump 2 in EW04. However, EEEI does not currently have information available showing the exact date that EW04-2 started pumping to the system.

If, after BES completes inspection of the extraction well pumps and screens, it is found that wells are stepping on one another, then process changes will be required. Any number of changes to the system could take place including replacing the manifold with an equalization tank or replacing extraction well pump motors with larger ones. Before any of these changes are considered, the extraction well evaluation that is part of the influent piping modification scope of work needs to be performed. Based on the findings of this inspection, EEEI will prepare and submit to the Illinois EPA a Technical Memorandum that provides a recommendation as to the most practical way to address equalizing flow pressures.

## 4.3 Existing Groundwater Extraction Wells

Four extraction wells are currently in operation. Construction details for extraction wells EW01 through EW04 are presented in the current O&M Manual. The wells are constructed with carbon steel riser sections and #304 stainless steel continuous wire wound screens. The wells were completed above grade, but protective casings were not installed. Concrete bollards protect the well risers. Additional construction details are presented in Table 4-2.

The building foundation was boxed out to allow access for piping runs. The original design drawings indicate that the EW01 force main and electric line, and the main three-phase, 480V electrical feed run from the southwest corner of the Erection Bay to the northwest corner of the P&T building. The remaining extraction well force mains and electric lines run from the wells to the south end of the P&T building. All force mains extend through the floor on the south end of the building, and all electric lines surface through the floor on the east side of the building. The electric lines were installed via direct burial except for the final 10 feet prior to entering the P&T building. The high-density polyethylene (HDPE) force mains extend through polyvinyl chloride (PVC) floor collars and connect to galvanized metal piping. All force mains are 2 inches in diameter with EW01 and EW02 reducing to a 1 inch diameter within the P&T building before the manifold piping, and EW03, EW04-1, and EW04-2 remaining 2 inches in diameter up to the manifold pipe.

There are two spare piping runs extending through the treatment building floor, and both are 2 inches in diameter. Additionally, two spare electrical conduit runs also enter the building. The existing force mains, except for EW04-2, have a pressure switch installed, followed by a direct-read pressure gauge, and flow control valve. The 1-inch lines have a Badger Recordall Model 70 totalizer, and the 2-inch lines have Badger Recordall Model 120 totalizer, except for EW04-2 which has a Hershey MVR160 totalizer. Each line has a 0.75-inch boiler drain (spigot) for sample collection, a second flow control valve, and a brass check valve before entering a 6-inch Schedule 80 PVC manifold pipe.

## 4.4 System Modeling

Operating and manufacturer's data from the ISCA pump-and-treat system was gathered to determine current operating conditions of the system. Based on the current operating conditions, extrapolations of the findings were made to determine whether the system could still function with the increased flow and influent concentrations from the three proposed well locations. The following sections discuss the findings of these investigations in detail.

## 4.5 Physical Component Capacities

From manufacturer literature, the Turbostripper has the capacity to treat 400 gpm of extracted groundwater based on the physical design of the column and blower sizing. The transfer pump has the capacity to discharge 450 gpm of treated groundwater, also based on manufacturer literature.

The effluent pipe is constructed of approximately 1,900 feet of Schedule 40 PVC pipe. The change in elevation from the ISCA pump-and-treat building to the Rock River is approximately 25 feet. This elevation change assumes a pump elevation of 755 feet amsl and a surface water elevation on the Rock River of 730 feet amsl. Assuming gravity flow from the treatment building with only pipe friction losses, i.e., no losses due to pipe bends, the effluent pipe is capable of draining at a flow rate of 380 gpm with a velocity of 4.27 feet/second. See the gravity flow calculations in Appendix A.

Calculations were also performed to determine the size of transfer pump needed to discharge water through the piping at an assumed discharge flow rate of 10% over the stripper column capacity (440 gpm) and with nine 90-degree elbows and eight 45-degree elbows. Based on the calculations with a safety factor of 2, the design head of the pump must be greater than 107 feet and have a design horsepower (hp) of equal to or greater than 14. The transfer pump installed at the plant is a 15-hp Goulds pump capable of discharging 450 gpm. At a maximum pump flow rate of 450 gpm and a safety factor of 1.25, the pump would exert a pressure of 90 pounds per square inch (psi) on the effluent piping. Six-inch Schedule 40 PVC pipe is rated for a working pressure of 180 psi in compliance with both American Society for Testing and Materials (ASTM) D1785 (pressure pipe) and ASTM D2665 (drain, waste, and vent pipe). See Appendix A for pressurized pipe calculations.

## 4.6 NPDES Permit

Treated groundwater is discharged to the Rock River under a NPDES permit through an outfall located on the former Beloit Corporation property. NPDES permit number IL0064564 was issued for the P&T System on March 25, 2005 and will expire on April 30, 2010. The treatment plant must operate in a manner that meets the requirements of the NPDES permit as reported on the DMRs. The permit establishes discharge load limits in pounds per day and concentration limits in milligrams per liter (mg/L) for the following VOCs: 1,2-dichloroethane (1,2-DCA), 1,1,1-TCA, TCE, PCE, 1,2-dichloroethylene (1,2-DCE), 1,1-dichloroethane (1,1-DCA), and 1,1-dichloroethylene (1,1-DCE). Table 4-3 presents the requirements of the NPDES permit.

The system capacity is based on influent groundwater contaminant concentrations, water flow rate, and air flow rate. Past influent and effluent contaminant concentrations were used to calculate the operating efficiency of the presently configured system. Appendix B presents the system influent and effluent concentrations from 2004 to 2006. Calculations performed by EEEI to determine the effluent concentrations following construction of the three new extraction wells and the ability to meet permit requirements are also presented in Appendix B. Based on this modeling, the presently configured system can handle the influent waste stream after the additional three extraction wells are added. Modeled effluent concentrations and their comparison to NPDES limits are shown in Table 4-4.

## 4.7 Air Permit

Because the Beloit Corporation is an NPL-listed site, a permit is not required. Although the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) exempts CERCLA sites from obtaining permits for on-site actions, all remedial actions must identify and comply with (or explicitly waive) the substantive provisions of permit regulations that are determined to be Applicable or Relevant and Appropriate Requirements (ARARs). However, if a permit were sought, since the site does not automatically fall within the exemptions listed under 35 IAC 201.146, a letter of inquiry and Potential to Emit calculations would need to be submitted to the Illinois EPA, Bureau of Air, Air Permit Section, to obtain written determination from the Agency concerning permit status.

Based on the expected waste stream influent concentrations as presented in Appendix B, the total amount of VOCs emitted per year would be negligible: 544 pounds per year (see Table 4-5). Therefore, the Bureau of Air likely would determine an air discharge exemption.

## Table 4-1
## Monitoring Well Survey Evaluation Results
## Beloit Corporation Site, Rockton, Illinois

| Well ID | Date | Time | Condition of Protective Cover, Cap, Lock | Condition of Cement Pad | Standing Water or Depressions | Condition/Type of Cap, Casing | Condition of Annular Space, Drain Holes | Well Depth (TOIC) | DTW (TOIC) |
|---|---|---|---|---|---|---|---|---|---|
| W26C | 12/19/06 | 14:00 | OK | None | -- | Threads at TOC are chipped. No reference mark on TOC. Loose coupling approximately 1.5 feet below TOC. | OK, but no drain holes. | 79.15 | 34.78 |
| W2 | 3/30/07 | – | Steel beam fell against well. Needs to be abandoned. | | -- | | | | |
| W13 | 12/19/06 | 15:15 | Damaged, well and protective cover bent approximately 45 degrees to east. | | | | | | |
| W14 | 12/19/06 | CNL | | | | | | | |
| W32 | 12/19/06 | 15:30 | OK | Cracked | -- | OK. J-plug cap. | OK, but no drain holes. | 32.74 | 28.39 |
| W28 | 12/19/06 | 15:35 | Missing manhole cover. | Portions washed away. | -- | Well TOC chipped. No reference mark on TOC. Cracked cap. | Gravel washed into annular space. | 31.61 | 22.70 |
| W15 | 12/19/06 | 15:50 | Damaged, well and protective cover bent 15 degrees east. | None | -- | TOC is approximately 3 feet below top of protective cover. | Cannot get visual on annular. No drain holes. | 33.55 (top of protective cover) | 24.15 (top of protective cover) |
| W1R | 12/19/06 | 16:00 | OK | None | Depression on west side of casing. Bentonite exposed. | OK | OK, but no drain holes. | 27.73 | 20.56 |

## Table 4-1
## Monitoring Well Survey Evaluation Results
## Beloit Corporation Site, Rockton, Illinois

| Well ID | Date | Time | Condition of Protective Cover, Cap, Lock | Condition of Cement Pad | Standing Water or Depressions | Condition/Type of Cap, Casing | Condition of Annular Space, Drain Holes | Well Depth (TOIC) | DTW (TOIC) |
|---|---|---|---|---|---|---|---|---|---|
| G107 | 12/20/06 | 09:45 | OK | OK | -- | Original cap missing. Plastic sample bottle is currently used as replacement cap. | OK, but no drain holes. | 50.84 | 41.89 |
| G101 | 12/20/06 | 10:20 | No protective cover. No lock. | None | -- | OK | No protective cover, can't see annulus. | Root obstruction in well 42 feet from TOIC. | 41.84 |
| G108D | 12/20/06 | 11:10 | OK | Large cracks. | -- | No cap. No reference mark on TOC. | OK, but no drain holes. | 70.60 | 35.95 |
| G108S | 12/20/06 | 11:15 | OK, but protective cover leans slightly to west. | Large cracks. | -- | Tilt of protective cover prevents cap from fitting on well. No reference mark on TOC. | OK, but no drain holes. | 42.73 | 36.52 |
| W44C | 12/20/06 | 11:40 | Broken lid. | OK | -- | OK. No reference mark on TOC. | Annular space is filling with leaves. | 56.45 | 21.93 |
| W18 | 12/20/06 | 11:45 | OK | None | -- | Casing wiggles at surface. | OK, but no drain holes. | 78.43 | 25.55 |
| G103D | 12/20/06 | 11:50 | OK | OK | -- | Riser pipe is bent. No reference mark on TOC. | Water on cement, no drain holes. | 49.45 | 24.01 |
| W37 | 12/20/06 | 12:15 | Broken lid (manhole needs special wrench to open). | OK | -- | J-plug cap and lock in ice. No reference mark on TOC. | Annulus is filling with dirt and leaves. | 38.24 | 28.85 |

## Table 4-1
## Monitoring Well Survey Evaluation Results
## Beloit Corporation Site, Rockton, Illinois

| Well ID | Date | Time | Condition of Protective Cover, Cap, Lock | Condition of Cement Pad | Standing Water or Depressions | Condition/Type of Cap, Casing | Condition of Annular Space, Drain Holes | Well Depth (TOIC) | DTW (TOIC) |
|---|---|---|---|---|---|---|---|---|---|
| P1 | 12/20/06 | 13:10 | No protective cover, no lock. | Broken | -- | Casing broken off at ground surface. J-plug cap. No reference mark on TOC. | Cannot see annulus. | 20.11 | 9.89 |
| G110 | 12/20/06 | CNL—Based on map location, it is within footprint of 867 Prairie. | | | | | | | |
| G109 | 12/20/06 | 13:50 | OK. Lid is bent, but lockable. | Cracked | -- | J-plug. Obstruction approximately 2.95 feet BGS. | Cannot get water level indicator past the obstruction at 4 feet below TOC. | | |
| W23B | 12/18/06 | 10:15 | Broken lid (manhole needs special wrench to open). | OK | -- | No reference mark on TOC. J-plug cap. | OK. Dirt is filling in annular space. | 49.60 | 25.98 |
| W31C | 12/20/06 | 15:20 | OK (manhole needs special wrench to open). | Cracked | -- | Could not open manhole to check lock, casing, annulus, depth to water, and total depth. | | | |
| W35C | 12/20/06 | 16:15 | Cover is broken and doesn't cover opening. | None | -- | Casing cracked at TOC. J-plug cap. No reference mark on TOC. | Annular is filling in with dirt. | 69.30 | 25.79 |
| W24 | 12/21/06 | 08:10 | OK | None | -- | Gouges at TOC. No reference mark on TOC. | OK | Wet mass of roots and vegetation at 25.90 feet below TOIC. | 25.90 |
| W34 | 12/20/06 | CNL—Buried under crushed gravel. | | | | | | | |
| W39 | 12/20/06 | CNL—Buried under stored materials. | | | | | | | |
| W49C | 12/20/06 | Located, but could not open bolts on manhole cover. | | | | | | | |

Key:

BGS = Below ground surface.
CNL = Could not locate.
TOC = Top of casing.
TOIC = Top of inside casing.
DTW = Depth to water.

**Table 4-2**
**Extraction Well Construction Details**

| Well ID | Casing Diam. (inches) | Total Depth (ft) | Top of Screen (ft) | Screen Length (ft) | Screen Slot Size (inches) | Depth to Pump Intake (ft) |
|---|---|---|---|---|---|---|
| EW01 | 8.0 | 57.3 | 21.7 | 30.0 | 0.010 | 52.3 |
| EW02 | 8.0 | 65.2 | 25.6 | 34.0 | 0.020 | 60.2 |
| EW03 | 8.0 | 71.8 | 26.2 | 40.0 | 0.020 | 57.8 |
| EW04 | 8.0 | 86.1 | 27.3 | 53.2 | 0.020 | 72.1 |

**Table 4-3**
**National Pollutant Discharge Elimination System Permit No. IL0064564**
**for the Beloit Corporation – Blackhawk Plant**
**Coverage: Outfall 001 Discharge to the Rock River**
**Effective Dates: May 01, 2005 to April 30, 2010**

| Parameter | Load Limits (lbs/day) | | Concentration Limits (mg/L) | | Sample Frequency | Sample Type |
|---|---|---|---|---|---|---|
| | 30-Day Average | Daily Maximum | 30-Day Average | Daily Maximum | | |
| Flow (MGD) | See Special Condition 1. | | | | 1/week | RIT* |
| 1,2-Dichloroethane** | 0.369 | 1.18 | 0.180 | 0.574 | 2/Month | Grab |
| 1,1,1-Trichloroethane** | 0.045 | 0.121 | 0.022 | 0.059 | 2/Month | Grab |
| Trichloroethylene** | 0.053 | 0.142 | 0.026 | 0.069 | 2/Month | Grab |
| Tetrachloroethylene** | 0.107 | 0.336 | 0.052 | 0.164 | 2/Month | Grab |
| 1,2-Dichloroethylene** | 0.051 | 0.135 | 0.025 | 0.066 | 2/Month | Grab |
| 1,1-Dichloroethane** | 0.045 | 0.121 | 0.022 | 0.059 | 1/Month | Grab |
| 1,1-Dichloroethylene** | 0.045 | 0.123 | 0.022 | 0.060 | 1/Month | Grab |

*Recording, indicating and totalizing.
**See Special Condition 8.

Special Condition 1. Flow shall be reported as a monthly average and daily maximum.

Special Condition 8. These parameters shall be reported in mg/L as a monthly average, and daily maximum concentrations are lbs/day as monthly average and daily maximum loads.

Key:

MGD = Millions of gallons per day.
mg/L = Milligrams per liter.

**Table 4-4**
**Summary Existing and Future Influent and Effluent Concentrations**
**Former Beloit Corporation - Blackhawk Facility**
**Rockton, Illinois**

| Chemical | Influent | | | | Effluent | | | | NPDES Limits | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Existing | | Future | | Existing | | Future | | 30-Day | Daily |
| | Average | Maximum | Average | Maximum | Average | Maximum | Average | Maximum | Average | Maximum |
| 1,1,1-Trichloroethane | 1.9 | 3.4 | 3.3 | 110.5 | 0.3 | 1.0 | 0.6 | 0.8 | 22 | 59 |
| 1,1-Dichloroethane | ND | ND | 0.6 | 0.6 | ND | ND | 0.1 | 0.1 | 22 | 59 |
| 1,2-Dichloroethane | ND | ND | 0.5 | 0.5 | ND | ND | 0.1 | 0.1 | 180 | 574 |
| Tetrachloroethene | 50.7 | 130.0 | 380.1 | 442.5 | 0.8 | 2.5 | 33.7 | 39.2 | 52 | 164 |
| Trichloroethene | 2.2 | 5.3 | 10.0 | 12.5 | 0.3 | 2.5 | 2.0 | 2.5 | 26 | 69 |
| 1,1-Dichloroethene | 0.7 | 1.0 | 1.1 | 1.4 | 0.3 | 0.3 | 0.1 | 0.2 | 22 | 60 |
| cis-1,2-dichloroethene | 1.0 | 2.5 | 109.3 | 110.5 | 0.3 | 1.0 | 12.3 | 12.5 | NE | NE |
| trans-1,2-dichloroethene | ND | ND | 2.0 | 2.0 | ND | ND | 0.2 | 0.2 | NE | NE |
| total 1,2-dichloroethene | 1.0 | 2.5 | 111.4 | 112.6 | 0.3 | 1.0 | 12.6 | 12.7 | 25 | 66 |

Note: All concentrations are in micrograms per liter.

Key:
- NPDES = National Pollutant Discharge Elimination System.
- ND = Not detected.
- NE = Not established.

## Table 4-5
## Summary of Air Discharge (Worst Case Scenario)
## Former Beloit Corporation - Blackhawk Facility
## Rockton, Illinois

| Chemical | µg/day | lbs/day | lbs/year | tons/year |
|---|---|---|---|---|
| 1,1,1-Trichloroethane | 5,292,944 | 0.01 | 4.27 | 0.002 |
| 1,1-Dichloroethane | 648,598 | 0.00 | 0.52 | 0.000 |
| 1,2-Dichloroethane | 558,666 | 0.00 | 0.45 | 0.000 |
| Tetrachloroethene | 519,574,520 | 1.14 | 419 | 0.209 |
| Trichloroethene | 14,624,180 | 0.03 | 11.79 | 0.006 |
| 1,1-Dichloroethene | 1,604,840 | 0.00 | 1.29 | 0.001 |
| cis-1,2-Dichloroethene | 129,795,220 | 0.29 | 104.64 | 0.052 |
| trans-1,2-Dichloroethene | 2,390,000 | 0.01 | 1.93 | 0.001 |
| **Total VOCs** | **674,488,968** | **1.49** | **544** | **0.272** |

Key:

µg/day = Micrograms per day.
lbs/day = Pounds per day.
lbs/year = Pounds per year.
VOCs = Volatile organic compounds.

# 5 Proposed Design of Treatment Systems

## 5.1 Groundwater Extraction Wells

Figure 5-1 shows the proposed configuration of the groundwater extraction wells and trenching locations to connect force main and electrical conduit runs to the existing P&T building. The extraction well locations are based on the modeled results presented in Section 3 of this report. New well EW05 will utilize the existing force main and electric line currently used by EW01. New wells EW06 and EW07 will have new lines installed to the existing spare, SP1. This configuration should limit the amount of trenching necessary by utilizing piping and conduit runs already in place, and decrease the disturbance to facility operations.

The EW05 piping run will be trenched across the southern end of the Erection Bay, from the southeast corner to EW01 on the southwest corner of the Erection Bay. The piping will connect to the existing EW01 force main and electric line. The existing EW01 electric shutoff is not securely connected to the mounting pole and will be repaired during installation of a tap for EW05. The existing EW01 pump will be moved from EW01 to EW05 (i.e., EW01 will be taken out of service). Backflow prevention will be placed in line on EW01 and EW05 so that extracted groundwater will not flow into the non-operating extraction well.

EW06 and EW07 will have a new force main and electrical conduit run to the existing spare, SP1, which runs between EW02 and the P&T building. The force main will be tied into the spare force main at this junction. Both force mains will have backflow prevention check valves installed. The current electrical line was installed via direct burial so no conduit exists to run the new electric line. For this reason, two options for running new electric line are possible. The first option is to continue the electrical conduit to the plant, but at a much shallower depth. Once the electric conduit reaches the treatment building, it will be tied into existing electrical conduit that enters through the building floor. A second option is to tie one well into the SP1 electric line and the other into the SP2 electric line at the junction of the new trench, and then direct-bury the lines. The different options will be explored, although tying into the existing direct burial electrical line will involve less trenching and fewer materials. The new wire sizes may not match the existing #2 wire sizes currently buried, but this should not be problematic since the new wire is anticipated to be smaller in diameter than the existing line. It is also not known if the direct burial lines are still in operating condition. A Meg-Ohm test will be performed on the lines prior to their use to ensure that the wire insulation has remained in working condition. Final design specifications will include provisions for Meg-Ohm testing.

Based on the SAI and modeling results in Section 3, pneumatic fracturing will be used to increase groundwater extraction rates at the Beloit site. EEEI has successfully implemented pneumatic fracturing at several other sites in Illinois to enhance permeability in formations and improve subsurface flow.

Pneumatic fracturing (U.S. Patent #5,032,042) is the injection of gas at high pressure and flow into soil or rock matrices in order to create fractures or fissures. Fractures or fissures occur when the pressure of the injected gas exceeds the natural in situ stresses, and the flow rate exceeds the natural permeability of the soils. In soil formations, pneumatic fracturing enhances permeability by creating fracture networks; in rock, the effect is dilation and extension of existing discontinuities, thereby improving the interconnection between existing fractures. The immediate benefit of pneumatic fracturing is improved access to subsurface contaminants so that liquids and vapors can be transported and extracted rapidly, which results in a cost savings during the installation and operational phases of a remediation project. Another advantage of pneumatic fracturing is that it can be applied within existing remedial systems as an enhancement and beneath or adjacent to existing structures and/or utilities.

At locations where a new/additional groundwater extraction well will be installed, fracturing will be performed prior to installing the well. First, an open borehole will be installed using 5.25-inch-diameter flight augers to an approximate depth of 55 feet below ground surface. A packer system will be used to isolate 3-foot intervals so that short bursts (~20 seconds) of compressed air (less than 200 pounds per square inch) can be injected into the interval to fracture the formation. Once a 3-foot interval is fractured, the equipment will be relocated within the borehole, and another interval will then be fractured. A total of 10 fracture intervals will be performed for each well.

Once fracturing is completed, the existing borehole will be widened to a diameter of 13.5 inches. After the borehole has been expanded, a vacuum and/or pressure will be applied to the borehole to reestablish the fracture pathways and ensure connection of the fractures to the extraction wells. This redevelopment is a necessary component of the well installation. Fracturing technology is limited by the size of the borehole. For the Beloit site, it has been determined that the extraction wells should be installed in 13.5-inch-diameter boreholes. However, fracturing equipment limits the size of the boring to an approximate 5-inch-diameter opening. In order to fracture and optimize the well size, well redevelopment has been identified as a necessary component.

New wells will be installed to match the previously installed extraction wells. This requires an 8-inch-diameter casing for all three wells. EW05 will be installed with a 30-foot screen from 25 to 55 feet BGS. EW06 and EW07 will have 35-foot screens from 25 to 60 feet BGS. All pumps will be installed approximately 5 feet from the bottom of the wells. The extraction wells were modeled at removal flow rates of 16 gpm, 15 gpm, and 15 gpm for EW05, EW06, and EW07, respectively. Protective concrete bollards will be installed around all new wells. Figure 5-2 shows the extraction well design.

Standard dimension ratio (SDR) 9 HDPE was used for the existing force mains feeding the P&T system. SDR 9 will be retained as the pipe class used for force mains. SDR 9 has a maximum working pressure rating of 200 psi.

Sizing of the three new extraction well pumps will require determining the horsepower of the existing extraction pumps already in the system. This information will be collected during the effluent pipeline modifications work being performed by BES. At that time, the well pumps will be pulled for inspection. As discussed earlier, the system is not performing up to design potentially due to pressure differences between the incoming force mains at the pipe manifold. At a minimum, EEEI will prepare a Technical Memorandum for sizing the new extraction well pumps. If the pressure difference proves to be the reason for the underperformance of the wells, then EEEI will expand the Technical Memorandum to describe in detail all of the options for correction with selection of the preferred design changes.

## 5.2 Groundwater Treatment System Upgrades

To date, most necessary upgrades that needed to be made to the system as highlighted in the Remedial Design Work Pan have been accomplished. BES is replacing the transfer pump and has overseen repair of the plant electrical feed and air stripper sump float control. The effluent line will be inspected, cleaned, and repaired, as necessary, during the upcoming fieldwork in connection with the Effluent Pipe Modification.

The findings based on modeling performed following the ISCA EE indicate that the current system has sufficient capacity to treat the increased mass loading of water introduced from the new extraction wells. The plant will also meet current Illinois EPA air discharge requirements for a remedial treatment system, and is physically capable of meeting the increased flow rate through the system based on motor and piping sizes. Therefore, the only changes required are based mainly on achieving a safer work environment, protection of system components, and tie-in of new extraction wells. These changes are detailed below.

A sump cover will be fabricated to ensure the safety of personnel working within the pump-and-treat building. The open control wiring conduit box on the sump control will also be repaired. To prevent continuing plant operation in the case of a pipe leak or burst, the sump level switch will be made operational.

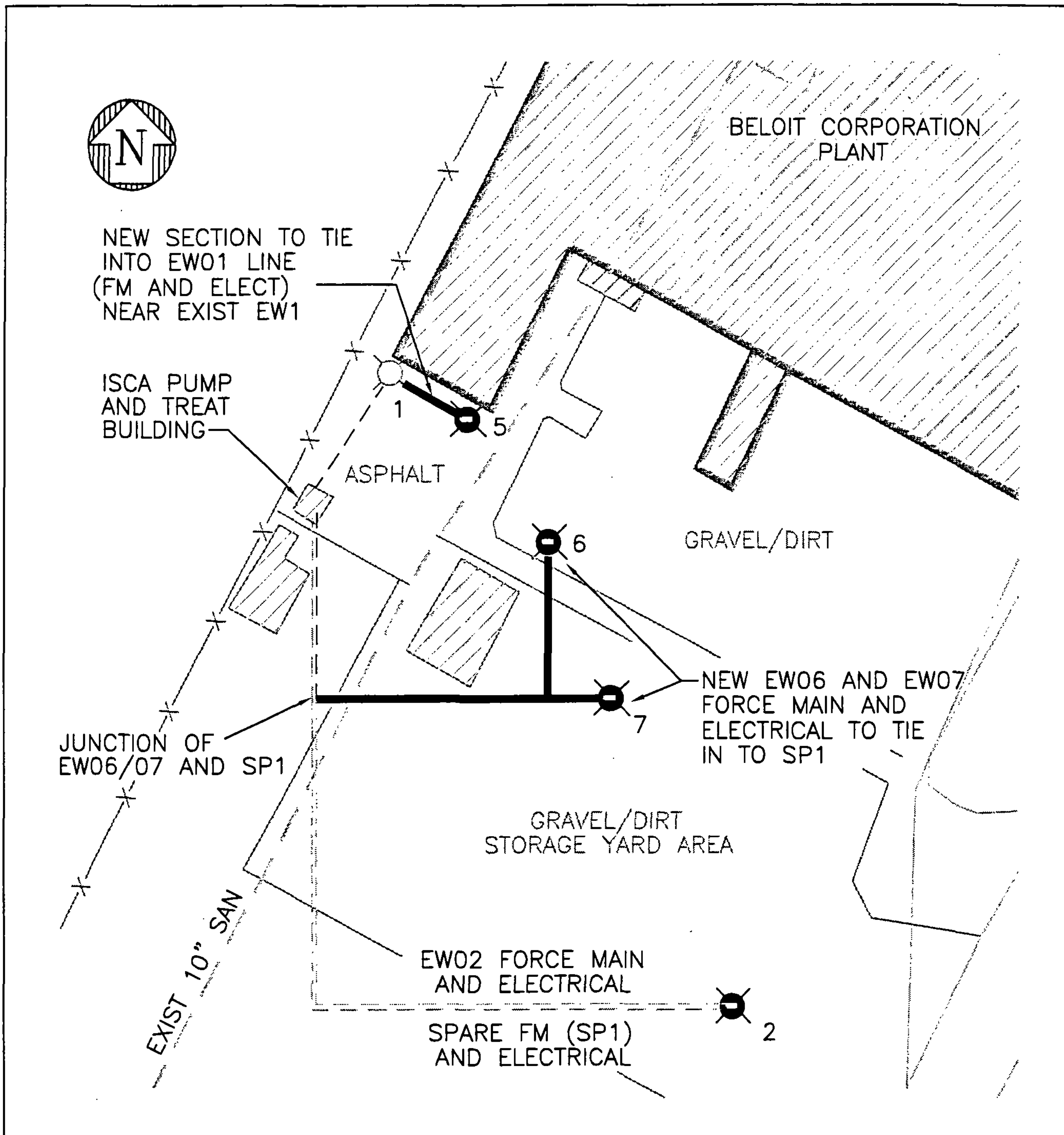
The influent header for well EW05 will share the current EW01 header and will not change. The spare force main to be used for EW06/EW07 does not currently have any header controls or flow-monitoring equipment installed, which will need to be constructed. The line already contains a transition at the floor from HDPE to galvanized piping and at the manifold from galvanized piping to PVC. Therefore, galvanized piping will be used to complete the header since the transition components are already in place. Figure 5-3 shows the configuration of the header piping and the placement of the influent line in relation to the other lines. The header will contain a pressure gauge, flow totalizer, check valve, flow control valves, and sampling port.

Figure 5-3 also compares the current Piping and Instrumentation Diagram (P&ID) with the new P&ID configuration following remedial design upgrade implementation. Completion of the treatment plant upgrade will entail additional programming for the PLC. Specifically, EW06 and EW07 will require programming unless the wells are to be run in hand mode only. Additionally, future system modifications, such as shutting down individual extraction wells, will require programming changes since the current programming requires EW03 and EW04 to be running for the air stripper to run. If EW03 and EW04 are not running, then the plant will shut down, making it impossible to take these wells off line with the current program.

## 5.3 Monitoring Well Upgrades

Under the selected site remedial alternatives, several monitoring wells will require upgrades and some will be slated for abandonment. If a well is slated for abandonment, the well or piping will have all exposed portions removed to a depth of 2 feet BGS. All bollards and concrete pads will also be removed. The remaining piping will then be filled with bentonite-cement slurry, and the open end will be capped. The areas around each well will then be backfilled to a level even with the existing ground surface. Specifications for well abandonment will be prepared as part of the design.

Based on the location of new extraction wells, additional monitoring wells will be constructed in order to monitor source area plume concentrations and pumping effects through the observed cone of influence. The locations of the new monitoring wells will be determined based on achieving these goals, which, at a minimum, means placing the new monitoring wells close to and generally up-gradient of the extraction wells. The final remedial design documents will contain monitoring well locations and construction criteria. A determination will be made based on the new monitoring well locations as to the need for above-grade (stick-up) or flush-mount completions. Protective concrete bollards will be placed around all wells completed above grade.




# EXTRACTION WELL AND TRENCH LOCATIONS

SCALE: 1" = 150'-0"

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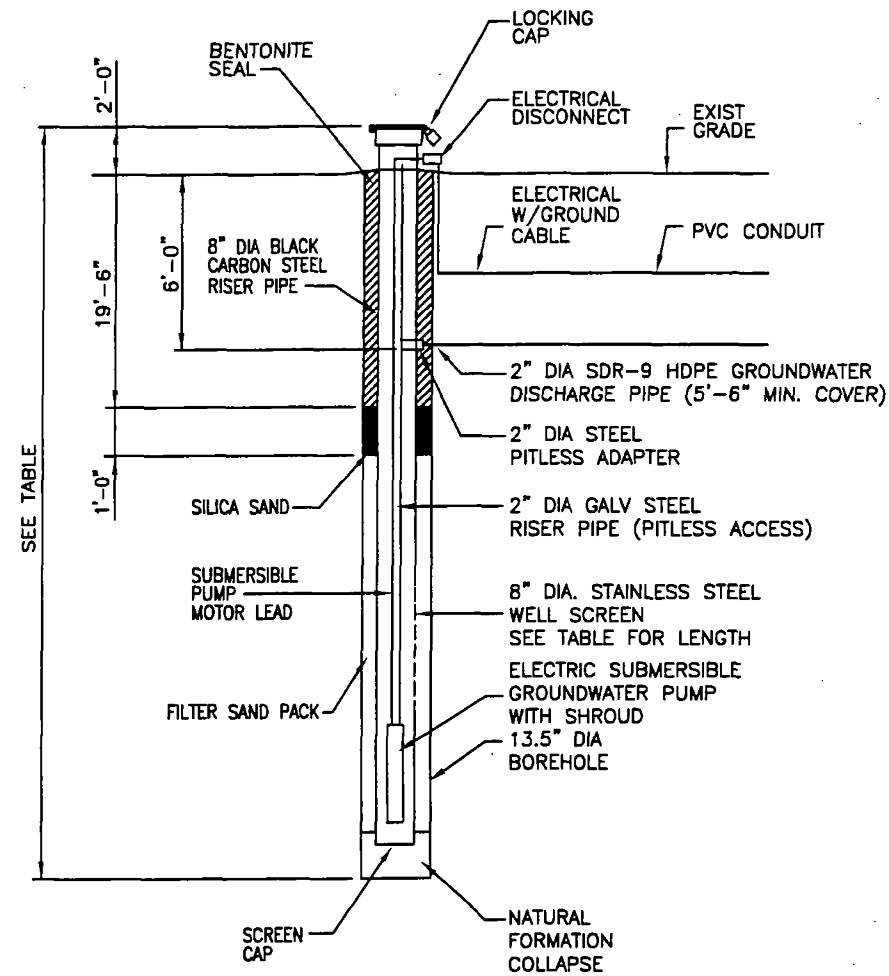
BUFFplot: 12/07 JJK REV 1

FIGURE 5-1 EXTRACTION WELL AND TRENCH LOCATIONS
BELOIT CORPORATION
ROCKTON, ILLINOIS




## TYP. EXTRACTION WELL DETAIL

NOT TO SCALE

### EXTRACTION WELL TABLE

| PROPOSED WELL NO. | SCREEN LENGTH | DEPTH TO PUMP | TOTAL DEPTH | PNEUMATIC FRACTURING INTERVAL |
|---|---|---|---|---|
| EW05 | 30' | 50' | 55' | 22' TO 55' |
| EW06 | 35' | 55' | 60' | 24' TO 60' |
| EW07 | 35' | 55' | 60' | 24' TO 60' |

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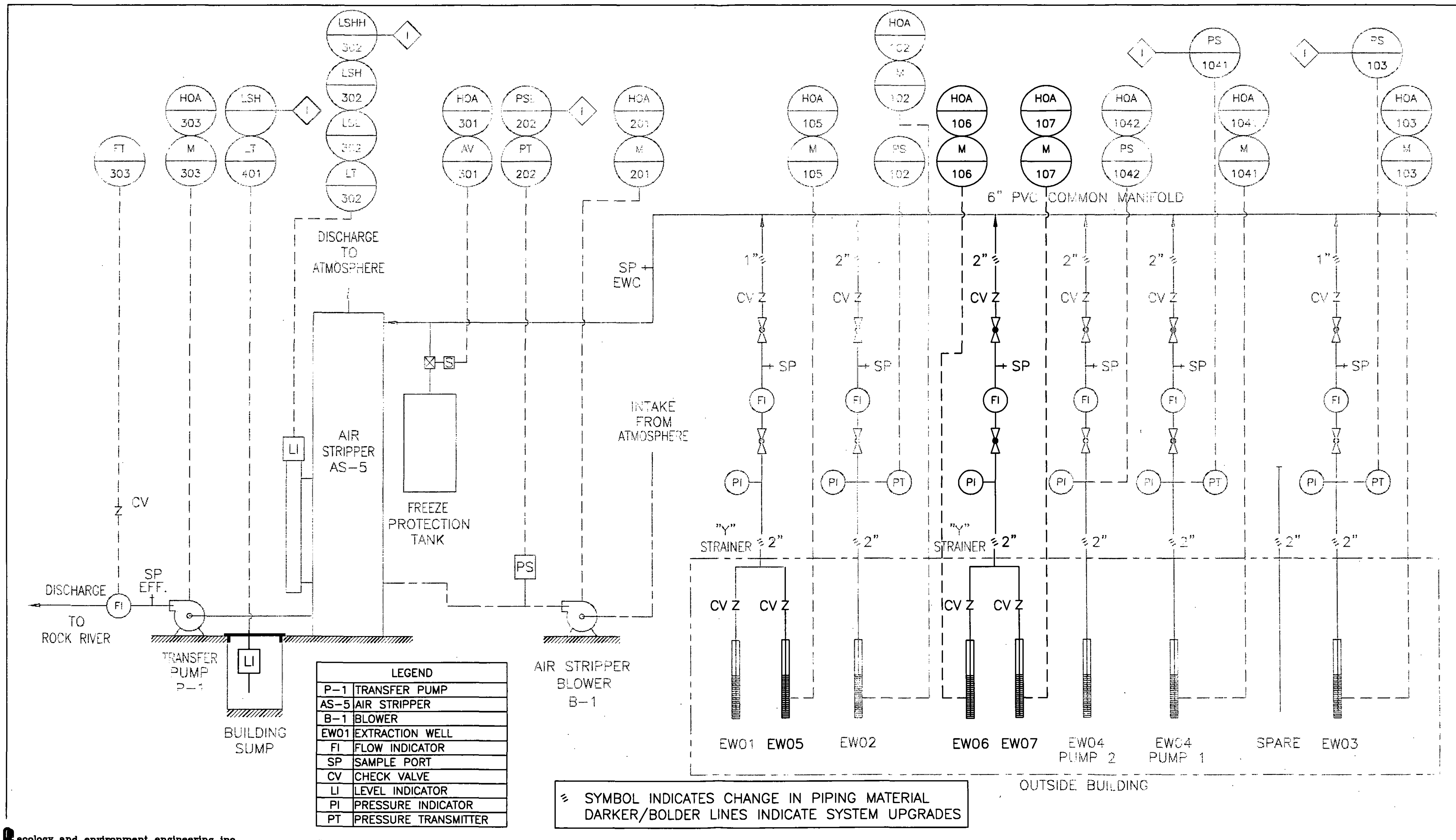
BUFFplot: 4/12/07 JJK REV 1

FIGURE 5-2 PROPOSED EXTRACTION WELL DETAIL
BELOIT CORPORATION
ROCKTON, ILLINOIS




LEGEND

| | |
|---|---|
| P-1 | TRANSFER PUMP |
| AS-5 | AIR STRIPPER |
| B-1 | BLOWER |
| EW01 | EXTRACTION WELL |
| FI | FLOW INDICATOR |
| SP | SAMPLE PORT |
| CV | CHECK VALVE |
| LI | LEVEL INDICATOR |
| PI | PRESSURE INDICATOR |
| PT | PRESSURE TRANSMITTER |

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FIGURE 5-3 PROPOSED PIPING AND INSTRUMENTATION DIAGRAM
BELOIT CORPORATION
ROCKTON, ILLINOIS

# 6 Additional Considerations

## 6.1 Health and Safety

Each contractor and/or subcontractor working on site will prepare a site-specific health and safety plan to govern their activities in relation to the specifications. The CHSP will be required in accordance with Occupational Safety and Health Administration Standards and Regulations contained in 29 Code of Federal Regulations (CFR) 1910 and 29 CFR 1926.

Trenching activities will require entering a trench at least 5 feet deep on several occasions, and will, at a minimum, include the following activities:

- Tying into the existing EW01 force main with the EW05 force main;
- Installing a check valve in the EW01 force main;
- Making pitless adapter connections to wells EW05, EW06, and EW07; and
- Tying into the spare force main piping south of the P&T building.

The safety of personnel in excavations is regulated by the Occupational Safety and Health Administration (OSHA) as specified in 29 CFR 1926.650-653. OSHA dictates standards for shoring, sloped sidewalls, hazardous atmosphere, access, and other aspects of excavation projects. The regulations dictate that personnel entering an excavation over 5 feet in depth work under an OSHA Safety Plan; that a minimum number of daily inspections of trenches and shoring are performed; and that an OSHA-defined Competent Person remains on site at all times when personnel are in trenches. OSHA regulations will be followed at all times throughout the construction process. The Contractor will verify conformance with these regulations.

## 6.2 Site Security

The selected remedial action contractor will be responsible for site security and for protection of their equipment and materials that are stored on site.

## 6.3 Purge and Decontamination Water

All purge and decontamination water will be run through the current pump-and-treat system for treatment and ultimate discharge to the Rock River.

## 6.4 Off-Site Borrow Materials

Approved off-site borrow materials will be required for many of the components of the final remedial action. The selected remedial action contractor will meet the specifications required for borrow material. Borrow material will be tested for polychlorinated biphenyls (PCBs), VOCs, semivolatile organic compounds (SVOCs), and metals concentrations greater than Tiered Approach to Corrective Action Objectives (TACO) Tier 1 residential standards. The contractor will submit borrow material samples and their testing results to the Illinois EPA. The source of borrow material will be made available for inspection by Illinois EPA, or another source will be found.

## 6.5 Disposal, Emission, and Discharge Requirements

Drill cuttings will be generated during the installation of new groundwater extraction and monitoring wells. All drill cuttings will be containerized and sampled for disposal analysis. The container holding any drill cutting materials will be labeled and dated while awaiting final disposition in accordance with Resource Conservation and Recovery Act (RCRA) requirements. It is currently anticipated that drill cuttings may be disposed of in a non-hazardous landfill. Concrete bollards, well casings, and other materials removed from abandoned wells and generated during remedial design construction activities will be staged on site until they can be transported to an off-site construction debris landfill. No permit-required emissions are expected during site construction activities. Purge and decontamination water will be handled as detailed in Section 6.3.

## 6.6 Site Survey

A site survey will be completed at the conclusion of all field activities and will include the locations of new extractions wells and monitoring wells constructed as part of the remedial design. Additionally, existing monitoring wells that have had repairs completed will be surveyed, and the north side of the well casing will be marked for future water measurements.

## 6.7 Permits and Access Agreements

It will be the remedial action contractor's responsibility to obtain the permits and access agreements needed for construction.

## 6.8 Operations and Maintenance

EEEI will prepare an O&M plan to cover implementation and long-term maintenance of the Remedial Action. The O&M Plan will incorporate all pertinent operational requirements of the ISCA pump-and-treat system and requirements for long-term groundwater monitoring. The intent of the O&M plan is to maximize the on-line operational time and performance of the treatment system. The O&M plan will supersede any existing plans.

EEEI will prepare an O&M manual to provide technical information to assure:

- Effective and efficient operation of the site remedy;
- The site remedy is monitored for performance and effectiveness; and
- All parties are aware of the specific O&M needs of the site/process.

Key items associated with the O&M plan include the following:

- **Weekly Operation and Maintenance and Reporting.** This includes coordination with the Engineer, mobilization, demobilization, system review, system adjustments, general and preventive system maintenance, and reporting of immediate repairs to the operating treatment system.
- **Monthly Operation and Maintenance, Sampling, and Reporting.** This includes coordination with the Engineer, mobilization, demobilization, system review, system adjustments, general and preventive system maintenance, sampling of regulatory discharges, and reporting of the system checks, flow information, and immediate repairs to the operating treatment system.
- **Unscheduled System Maintenance and Reporting.** This includes mobilization and demobilization to handle and maintain unscheduled treatment system shutdowns as required, and communication and coordination with the Engineer. This also includes the evaluation of system problems and the ability to restart the system and continue treatment of the environmental waste streams.
- **System Startup and Monthly System Review and Evaluations.** Restart the air stripper and groundwater extraction pumps to evaluate equipment performance on a monthly basis.

In addition to the items listed above, EEEI will develop multiple checklists, which will document the inspections and pertinent system operational data to allow for a thorough evaluation of system performance, as well as identify potential modifications to the operations to increase its operational efficiencies.

The O&M manual will be one complete, stand-alone document that can be implemented by individuals with limited familiarity with the site/process. The relevant portions of the documents referenced in the O&M manual (such as manufacturers' O&M manuals, shop drawings, engineering specifications, and relevant and appropriate requirements of regulatory agency regulations and documents) will be incorporated in the O&M manual as appropriate.

The Guidance Document EPA/542/R-05/010, *O&M Report Template for Ground Water Remedies (with Emphasis on Pump and Treat Systems)*, will be used in the writing of the O&M Plan. A draft O&M Plan will be submitted for written comments as a pre-final 95% Design Document submission. Comments from Illinois EPA will be incorporated into a final O&M Plan, and three copies of the document will be submitted for distribution. The O&M Plan will be written to include changes that will be made to the system following implementation of the Remedial Design. Following implementation of the Remedial Design, the O&M Plan may require minor revisions.

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# A

# Effluent Discharge Pipe and Transfer Pump Calculations

# Memorandum

ecology & environment engineering, inc.
International Specialists in the Environment

**Date:** April 12, 2007

**To:** Beloit Corporation 30% Design Report

**Prepared by:** Tom Campbell, P.E.

**Checked by:** Neil Brown, P.E.

**Subject:** Discharge Pipe and Transfer Pump Sizing

## Objective

The objective of this technical memorandum is to verify that the size of the existing effluent discharge line is sufficient to support the increase in flow associated with the addition of three new groundwater extraction wells. Additionally, the size of the existing transfer pump was evaluated to ensure that it has the necessary capacity.

## Background

The current remedy at the Beloit Corporation site includes four groundwater extraction wells operating with five pumps. It has been proposed that three additional extraction wells be added to the existing system to address the source area portion of the groundwater contaminant plume. The existing groundwater extraction system focuses on the edge of the plume by using the existing down gradient extraction wells. The extracted groundwater is treated via air stripping and discharged under a National Pollutant Discharge Elimination System (NPDES) permit to the Rock River via the effluent discharge line.

## Discussion

### *Determining Gravity Flow through the Pipe*

When possible, pipe diameter would be sized in accordance with the calculations outlined in the following section (*Determining Pipe Size*). However, the effluent pipe is already in place and the following calculations were performed to ensure that the existing pipe is of sufficient diameter to handle the volume of effluent. Using Manning's flow equation, the pipe was first checked to see if it could drain relying on just gravity flow.

$$V = \frac{1.486 \cdot R^{0.667} \cdot S^{0.5}}{n}$$ (Equation 1)

Where V is the average flow velocity, R is the hydraulic radius in feet, and S is the pipe slope expressed in feet per foot. Manning's flow coefficient, n, is 0.010 for plastic pipe. The hydraulic radius is equal to the fullness factor multiplied by the pipe inside diameter in feet. Once the velocity is obtained the flow rate can be calculated with the equation:

$Q = 449 \cdot V \cdot A \cdot d^2$ (Equation 2)

A is the area factor obtained from the fullness factor table.

The effluent pipe is constructed of approximately 1,900 feet of Schedule 40 polyvinyl chloride (PVC) pipe. With a pump elevation of 755 ft MSL and a surface water elevation on the Rock River of 730 ft MSL, the elevation change would be approximately 25 feet. Assuming gravity flow from the treatment building with only pipe friction losses, i.e., no losses due to pipe bends, the effluent pipe is capable of draining at a flow rate of 380 gallons per minute (gpm) with a velocity of 4.27 ft/sec. These calculations are summarized in the attached worksheets.

Given that the existing air stripper has a treatment capacity of 400 gpm, almost the full capacity of the air stripper discharge could be gravity drained provided the effluent line was a straight run of pipe. However, a pump was installed and is used to overcome frictional losses associated pipe bends and fittings.

In order to size the transfer pump, additional calculations were performed. In order to be conservative, a flow rate of 410 gpm (110% of the air stripper capacity) was used. Additionally, it was assumed that nine 90-degree elbows and eight 45-degree elbows were components of the effluent pipeline. Based on the calculations and with an added safety factor of 2, the design head of the pump must be greater than 107 feet and have a design horsepower of equal to or greater than 14. The existing transfer pump has a 15-HP motor capable of pumping at a discharge rate of 450 gpm. It was also determined that at a maximum pump flow rate of 450 gpm, the pump would exert a pressure of 90 psi on the effluent piping. Six-inch Schedule 40 PVC pipe is rated for a working pressure of 180 psi in compliance with both ASTM D1785 (pressure pipe) and ASTM D2665 (drain, waste & vent pipe).

These numbers were arrived at in the following manner.

***Determining Pipe Size***

The calculation used to determine pipe size is the continuity equation: $Q = A \cdot V$ (Equation 3)

Where Q equals volumetric flow rate, A is the area of the pipe based on internal diameter, and V is the velocity of the water (Munson 1990). Flow rate is known from the manufacturer's pump data or design calculations, and the inner diameter of the piping material can be obtained from plastic pipe manufacturers' literature (Indelco 2003, Plastic Pipe Institute 2000, Harvel Plastics 2005, ISCO 2005). Piping diameter should be selected so that the velocity is greater than 4 feet per second (Ten State Standards 1990) and less than 10 feet per second (Plastic Pipe Institute 2000). A standard target is 7 feet per second (USACE 1999). If solids are present in the flow then a velocity of less than 4 feet per second should be avoided to prevent solids from settling on the bottom of the pipe and hindering flow.

Data supplied by the pump manufacturer, show that the transfer pump discharge port has a maximum flow rate of 450 gpm. The six inch schedule 40 pipe has an inner diameter of 6.031 inches. The velocity through the pipe has been calculated to be approximately 5 feet per second at maximum flow. In order to get a velocity above 7 feet per second, the pipe diameter would need to be 5 inches in diameter which is a nonstandard size.

***Determining Head Loss***

The calculation used to determine head loss is Bernoulli's equation which is made up of velocity head, pressure head, elevation head, and head losses:

$$\frac{V_1^2}{2g} + \frac{P_1}{\rho} + Z_1 = \frac{V_2^2}{2g} + \frac{P_2}{\rho} + Z_2 + h_L \qquad \text{(Equation 4)}$$

Where V is velocity, g is the acceleration due to gravity, P is pressure, $\rho$ is the density of water, Z is elevation, and $h_L$ is head loss (Hwang 1987). Head losses are made up of friction losses and losses due to constrictions, expansions, fittings, joints, and pipe bends. For our scenario, the change in velocity over any section of pipe is negligible so the equation becomes:

$$\frac{P_1}{\rho} - \frac{P_2}{\rho} = (Z_2 - Z_1) + h_L \qquad \text{(Equation 5)}$$

The change in pressure head is equal to the change in elevation head plus head losses. The change in elevation head may be positive or negative depending on whether the piping is running uphill or downhill. The change in elevation for the piping system was determined from a topographic map of the site. As stated previously, the elevation change from the ISCA pump-and-treat building to the Rock River is approximately 25 feet.

The calculation used to determine head loss due to friction was the Darcy-Weisbach formula:

$$h_f = \frac{f \cdot L \cdot V^2}{2 \cdot D \cdot g} \qquad \text{(Equation 6)}$$

Where f is the Moody friction factor, L is the length of pipe, V is the velocity of water in the pipe, D is the pipe inner diameter, and g is the acceleration due to gravity (Hwang 1987). The above equation may be used for any fully-developed, steady, incompressible pipe flow.

The Moody friction factor was determined by the equation:

$$f = \frac{1.325}{[\ln(\frac{e}{3.7D} + \frac{5.74}{\mathrm{Re}^{0.9}})]^2} \quad \text{where } \mathrm{Re} = \frac{D \cdot V}{\nu} \qquad \text{(Equation 7)}$$

The symbol e is the specific roughness of the pipe material, Re is the Reynolds number, and v is the kinematic viscosity of water. The specific roughness was modeled at 0.01 (PPI 2005) and the kinematic viscosity for water at 50 degrees Fahrenheit, $1.41 \times 10^{-5}$ $ft^2$/sec, was used.

The calculated head loss, $h_f$, gives the loss per 100 feet of piping. Head losses due to pipe fittings were modeled using equivalent lengths. The actual length of pipe along with the equivalent length of pipe were summed and divided by 100 to give the total length of pipe to be multiplied by the head loss, $h_f$, as calculated using the Darcy-Weisbach formula.

Since the transfer pump has water gravity fed by piping directly into the pump there is no suction head. A pipe that has to "pull" water up from a lower elevation would have a suction head associated with it. There is also no drawdown to consider as there would be with an extraction well pump since the water entering the pump can be considered to always be at the same elevation. However, elevation head from the site topography does play a factor as was discussed in the gravity flow calculations above. An elevation head of -25 feet is present. A total head, $h_T$, is calculated by adding together all friction head and elevation head values. These calculations are summarized in the attached worksheets.

***Determining Pump Motor Size***

The pump motor currently installed at the P&T building is 15 horsepower (Hp). Based on spreadsheet calculations, a 14 HP motor is needed to pump water to the outfall location at 450 gallons per minute. The equation used to determine required horsepower is:

$$HP = \frac{Q \cdot SG_{H_2O} \cdot H_T}{3956 \cdot Efficiency} \quad \text{(Equation 8)}$$

The specific gravity of water is 1.0, and the efficiency used was 85 percent.

***Determining Pipe Pressure Rating***

Pressure in the pipe was calculated using the following equation:

$$P = \frac{\rho \cdot (\text{Pump head} + \text{elevation head} + \text{head loss})}{144} \quad \text{(Equation 9)}$$

The pump head is determined by taking Equation 8 and solving for $H_T$. This gives the exact head supplied by the selected pump, which usually does not supply exactly the same HP as the design HP. The same friction head and elevation head values calculated for the piping network are used. The values are all summed and multiplied by the density of water to determine the pressure within the pipe. Pressure in the pipe was calculated as 90 pounds per square inch (psi) with an added safety factor of 25%. These calculations are summarized in the attached worksheet.

## Conclusion

The effluent discharge piping and pump motor is sized correctly for discharge to the Rock River. Schedule 40, 6-inch PVC pipe is pressure rated for a maximum internal working pressure of 180 psi (Harvel Plastics 2007).

## References


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**Worksheet for determining Gravity Flow conditions through the Beloit Effluent Pipe**

Pipe consists of a 6-inch Schedule 40 Polyvinyl Chloride (PVC) pipe.

**Known**

| | |
|---|---|
| Inner Diameter (d) = | 6.031 inches |
| Length = | 1,900 feet |
| Elevation change to MH = | 25 feet |

**Calculated**

Slope (S) = 0.013158 ft/ft

**V = 4.273107 ft/sec**

**Q = 380.6249 gpm**

**Equations**

Gravity Flow through Pipes

$$V = \frac{1.486 \bullet R^{0.667} \bullet S^{0.5}}{n}$$

$$R = f \bullet d$$

V = Average flow velocity, ft/sec
R = hydraulic radius, feet
S = Slope of pipe, feet per foot
n = Manning's flow coefficient, 0.010
f = Fullness factor from table
d = Inside diameter, feet

$$Q = 449 \bullet V \bullet A \bullet d^2$$

Q = volumetric flow rate, gpm
A = Area factor from fullness factor table

Fullness Factors

| h/d | f | A |
|---|---|---|
| 0.05 | 0.0326 | 0.0147 |
| 0.10 | 0.0636 | 0.0409 |
| 0.15 | 0.0929 | 0.0739 |
| 0.20 | 0.1206 | 0.1118 |
| 0.25 | 0.1466 | 0.1535 |
| 0.30 | 0.1710 | 0.1982 |
| 0.35 | 0.1935 | 0.2450 |
| 0.04 | 0.2143 | 0.2934 |
| 0.45 | 0.2331 | 0.3428 |
| 0.50 | 0.2500 | 0.3927 |
| 0.55 | 0.2649 | 0.4426 |
| 0.60 | 0.2776 | 0.4920 |
| 0.65 | 0.2881 | 0.5404 |
| 0.70 | 0.2962 | 0.5872 |
| 0.75 | 0.3017 | 0.6319 |
| 0.80 | 0.3042 | 0.6736 |
| 0.85 | 0.3033 | 0.7115 |
| 0.90 | 0.2980 | 0.7445 |
| 0.95 | 0.2864 | 0.7707 |
| 1.00 | 0.2500 | 0.7854 |

**Beloit Corporation: Calculations for Transfer Pump Motor Sizing**

**Constants, Variables, and Assumptions**

| | | |
|---|---|---|
| ρ = | 62.428 | lbm/ft^3 |
| ν @ 50°F = | 1.41E-05 | ft^2/sec |
| e = | 0.01 | ft |
| g = | 32.174 | ft/sec^2 |
| SG of water= | 1 | |
| π = | 3.1415927 | |

ρ = density
ν = kinematic viscosity
e = specific roughness
g = gravity
SG = specific gravity
π = pi
Re=Reynold's Number
f = Moody Friction Factor

gpm=gallons per minute
Q=Maximum Flow Rate
ID=Inner Pipe Diameter
A=Inner Cross-Sectional Area of Pipe
V=Fluid Velocity
bgs=below ground surface
hf=Energy loss due to friction
L=100 feet of pipe
$L_P$=Actual Length of Pipe
$L_e$=Equivilant Length of Pipe Fittings
h1=Head Loss Due to Pipe Friction

*Assumptions*
T = 50°F
Turbulent Flow

**Table 1: Calculations for Flow through Effluent Pipe and Transfer Pump Sizing**

| Well Number or Location | Flow | Flow | Pipe Description | Inside Diameter of Pipe | Inside area of Pipe | velocity | Reynolds Number | Moody friction factor | Energy loss from friction in 100 feet of pipe | Length of Pipe | Equivalent length of fittings |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | GPM | $ft^3$/sec | | feet | $feet^2$ | feet/sec | unit less | unit less | feet | feet | feet |
| Equation | Q | Q | | ID | A=π*(ID/2)^2 | V=Q/A | Re=ID*V/ν | f=1.325/[ln(e/3.7ID+5.74/$Re^{0.9}$)]$^2$ | hf=(f*L*V^2)/(2*ID*g) | $L_P$ | $L_e$ |
| Effluent Pipe | 440 | 0.98032 | 6 inch schedule 40 PVC | 0.503 | 0.198 | 4.94153426 | 1.761E+05 | 0.0489 | 3.69 | 1900 | 226 |

| Well Number or Location | Head Loss due to friction in pipe | Suction | Static Water Level in well | Drawdown | Pumping Water Level | Elevation Gain | Total Head | Safety Factor Added | Design Head | Horsepower required for pump | Design Horsepower |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | feet | feet bgs | feet bgs | feet | feet bgs | feet | feet | feet | feet | HP | Horsepower |
| Equation | $h_1$ | | | $D_D$ | $h_2$ | $h_3$ | $h_T$ = h1 + h2 + h3+FM ht+FM ht | 2.00 | | HP=(($h_T$*Q [in GPM] * SG / 3956) / 85% | |
| Effluent Pipe | 78.50 | 0 | 0 | 0 | 0 | -25 | 53.50 | 106.99 | 107 | 14.00 | 15.00 |

**Table 2: Equivalent Length Calculations for Effluent Pipe**

| Fitting Type | Effluent Line (6-inch PVC) | No. | Equivalent Length (feet) |
|---|---|---|---|
| 90 degree elbow | 18.0 | 9 | 162.00 |
| 45 degree elbow | 8.0 | 8 | 64.00 |

**Fittings (equivalent lengths for each fitting were approximated using thermoplastic piping tables provided by Harrington Industrial Plastics, Inc. January 1990 Engineering Handbook)**

**Calculated Pressure, $P_T$, Exerted within Effluent Piping**

**Equation 1: Total Head**

$$h_T = \frac{HP \times 3956 \times Eff}{Q \times SG_{H_20}}$$

Calculated head for 15-HP pump at 450 gpm (EQ. 1) = 112.09 feet

Using:

Horsepower (HP) = 15
Efficiency (Eff)= 85 %
Flowrate (Q) = 450 gpm
Specific Gravity of H20 (SG) = 1.0

**Equation 2: Friction, Darcy-Weisbach Formula**

$$h_f = \frac{f \cdot L \cdot v^2}{2 \cdot D \cdot g}$$

Calculated friction within the effluent piping (EQ. 2) = 78 feet

Using:

Friction Loss calculated in Table 1 using Equation 2.

**Table 3: Pressure Exerted within Effluent Piping**

| Location | Elevation | Elevation | delta z | Total Head | $H_f$ | delta P | $P_T$ | FS = 1.25 |
|---|---|---|---|---|---|---|---|---|
| | z1 | z2 | Z (ft) | ft | ft | psi | psi | psi |
| Effluent Pipe | 755 | 730 | -25 | 112 | 78 | 72 | 72 | 90 |

6-inch Schedule 40 PVC pipe maximum working pressure*= 180 psi

*Harvel Plastics, Inc. (2007) accessed on the Web at http://www.harvel.com/tech-specs-pvc-pipe-40.asp

## PROFESSIONAL ENGINEER CERTIFICATION PAGE

**Note:** The specifications and drawings associated with this submittal do not constitute a full/complete design and are not certified. The following text has been provided to show that upon completion how the design will be certified by a State of Illinois licensed Professional Engineer.

Pursuant to Chapter 225 Illinois Complied Statutes (ILCS) 325/15, this application is required to be submitted under the seal of al Illinois-licensed professional engineer. This page provides the signature and seal to comply with the regulation.

I hereby certify that this 100% Design Specifications for the Beloit Corporation's Blackhawk facility located in Rockton Township, Winnebago County, Illinois, was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Illinois. All engineering calculations and recommendations included therein are in accordance with standard and appropriate engineering practices.

Name:

License Number:

State:

Expiration Date:

Name
Responsible Charge

Seal

Date

## DIVISION 1 – GENERAL REQUIREMENTS

**DIVISION 2 – SITE WORK**



**DIVISION 3 – CONCRETE**



**DIVISION 11 – EQUIPMENT**



**DIVISION 13 – SPECIALTY CONSTRUCTION**

**DIVISION 15 – MECHANICAL**



**DIVISION 16 – ELECTRICAL**

To be Added

## 1.0 GENERAL

### 1.1 ABBREVIATIONS

A. Whenever the following abbreviations are used in these Contract Documents, they are to be construed as represented below:

| | | |
|---|---|---|
| 1. | °F | degrees Fahrenheit |
| 2. | A | Ampere |
| 3. | ac | alternating current |
| 4. | AASHTO | American Association of State Highway and State Transportation Officials |
| 5. | ANSI | American National Standards Institute |
| 6. | AOS | Apparent opening size. |
| 7. | ASTM | American Society for Testing and Materials |
| 8. | AWWA | American Water Works Association |
| 9. | BERA | Baseline Ecological Risk Assessment |
| 10. | BMP | best management practice |
| 11. | CD | compact disk |
| 12. | CFR | Code of Federal Regulations |
| 13. | Clayton | Clayton Group Services, Inc. |
| 14. | cm/sec | centimeters per second |
| 15. | COP | Construction Operations Plan |
| 16. | CQC | Contractor Quality Control |
| 17. | CSSP | Contractor Site Safety Plan |
| 18. | cy | cubic yard |
| 19. | DIGGER | Chicago Utility Alert Network |
| 20. | DOT | United States Department of Transportation |
| 21. | E & E | Ecology and Environment, Inc. |
| 22. | EEEI | Ecology and Environment Engineering, Inc. |
| 23. | EPA | United States Environmental Protection Agency |
| 24. | ERT | Environmental Response Team |
| 25. | FGCS | Federal Geodetic Control Subcommittee |
| 26. | GPS | global positioning system |
| 27. | H | horizontal |
| 28. | HDB | hydrostatic design basis |
| 29. | HDPE | High-Density Polyethylene |
| 30. | HHRA | Human Health Risk Assessment |
| 31. | IAC | Illinois Administrative Code |
| 32. | ID | identification or inside diameter |
| 33. | IDOTSPEC | Standard Specifications for Road and Bridge Construction |
| 34. | IDPH | Illinois Department of Health |
| 35. | Illinois EPA | Illinois Environmental Protection Agency |
| 36. | lb | pound |
| 37. | LCC | Lake Calumet Cluster |

| | | |
|---|---|---|
| 38. | m | meter |
| 39. | max. | maximum |
| 40. | min. | minimum |
| 41. | MHP | Materials Handling Plan |
| 42. | MUTCD | Manual on Uniform Traffic Control Devices |
| 43. | MWH | Montgomery Watson Harza |
| 44. | MWRD | Metropolitan Water Reclamation District of Greater Chicago |
| 45. | NAD83 | North American Datum of 1983 |
| 46. | NAVD | North American Vertical Datum |
| 47. | NEC | National Electric Code |
| 48. | NEMA | National Electric Manufacturers Association |
| 49. | NESHAP | National Emissions Standards for Hazardous Air Pollutants |
| 50. | NFPA | National Fire Protection Association |
| 51. | NGVD | National Geodetic Vertical Datum |
| 52. | NIOSH | National Institute for Occupational Safety and Health |
| 53. | no. | number |
| 54. | NPDES | National Pollutant Discharge Elimination System |
| 55. | O2 | oxygen |
| 56. | OD | outside diameter |
| 57. | OSHA | Occupational Safety and Health Administration |
| 58. | OVA | organic vapor analyzer |
| 59. | PCB | polychlorinated biphenyl |
| 60. | PE | polyethylene |
| 61. | PLS | pure live seed |
| 62. | PNEZD | point number, northing, easting, elevation, and description |
| 63. | PPE | personal protective equipment |
| 64. | psf | pounds per square foot |
| 65. | psi | pounds per square inch |
| 66. | psig | pounds per square inch gauge |
| 67. | PVC | polyvinyl chloride |
| 68. | QA | quality assurance |
| 69. | QAO | quality assurance officer |
| 70. | QC | quality control |
| 71. | RCRA | Resource Conservation and Recovery Act (as amended) |
| 72. | SDR | standard dimension ratio |
| 73. | SOP | Standard Operating Procedure |
| 74. | SPCS | State Plan Coordinate System |
| 75. | SVOC | semivolatile organic compound |
| 76. | SWPPP | stormwater pollution prevention plan |
| 77. | TACO | Tiered Approach to Corrective Action Objectives |
| 78. | TSCA | Toxic Substances Control Act |
| 79. | TSD | Treatment, Storage, and Disposal |
| 80. | UL | Underwriters Laboratory |
| 81. | USDA | United States Department of Agriculture |
| 82. | USDOT | United States Department of Transportation |

| | | |
|---|---|---|
| 83. | USCG | United States Coast Guard |
| 84. | UV | ultraviolet |
| 85. | V | vertical or Volt |
| 86. | VOC | volatile organic compound |

## 1.2 DEFINITIONS

A. These definitions are made for the purposes of this contract only.

1. Backfill – Replacement of excavated material with suitable material compacted as specified.
2. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other approved pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
3. Construction/Construction Activities - All Contractor activities specified by this contract or as required to carry out the Work.
4. Construction Entrance - The gate leading into the Lake Calumet Cluster property along South Stoney Island Avenue just north of the Paxton II Landfill.
5. Day - Unless otherwise specified, day(s) shall mean Calendar Day(s).
    a. Business Day: Any day other than Saturday, Sunday, or Holiday.
    b. Calendar Day: The time period of twenty-four hours measured from midnight to the next midnight.
    c. Non-Working Day: The following are Non-Working Days:
        1. Sunday;
        2. Holiday;
        3. A day upon which the Agency issues a suspension order; and/or
        4. A day on which the Contract specifically requires the Contractor to suspend the Work.
    d. Working Day: A day not otherwise defined as a Non-Working Day.
    e. Unworkable Day: A partial or whole day the Agency in its sole opinion declares to be unworkable because of unusually severe weather, or another condition beyond the control of the Contractor that prevents satisfactory and timely performance of the Work, when such performance, if not hindered, would have otherwise progressed toward completion of the Work.
6. Engineer - The authorized representative of the Agency, who will be present on site as the principal point of contact, and will be assigned to make detailed inspections of any and all portions of the Work. The term Engineer is defined as Ecology and Environment Engineering, Inc. (EEEI), 368 Pleasant View Drive, Lancaster, New York 14086, with principal office at: 33 North Dearborn Street, Suite 501, Chicago, Illinois 60602. All engineering work will be under the supervision of an engineer currently licensed in the State of

Illinois. Gender-specific pronouns are used in this document for clarification and should be considered generic in meaning.

7. Equipment - All machinery and equipment with the necessary supplies for upkeep and maintenance; also tools and apparatus necessary for the proper construction and acceptable completion of the Work.
8. Frost Line – The frost line is forty-two (42) inches for Winnebago County.
9. Hazardous Waste - Solid waste classified as hazardous according to the Resource Conservation and Recovery Act Amendments (1984) and guidelines thereto.
10. Materials - Any substances specified for use in the project and its appurtenances.
11. Off Site - Outside the legal property boundary of the site.
12. Progress Reports - Submittals by the Contractor showing progress and up-to-date status of the project and anticipated variances both in work and finances.
13. Project Manager:
    - Contractor's Project Manager – The employee of the Contractor who is responsible for the quality of work and budget for the items to be performed by the Contractor. The Contractor's Project Manager is authorized to communicate with the Agency's Representative on all matters.
    - Engineer's Project Manager - The Engineer's Project Manager is responsible for providing adequate staff to monitor the Contractor's work, and for remaining within the budget authorized by the Agency. The Engineer's Project Manager is authorized to report directly to the Agency concerning the work of the Contractor.
14. Project/Project Work - Any and all work specified herein, including any associated site improvements and appurtenances and structures to be constructed. The project is more fully described elsewhere in the Contract Documents, including the Agreement.
15. Replacement – Installation of a like element in the same or near-same physical location to function in place of an existing element, normally due to damage, wear, or obsolescence of the element.
16. Restoration – All work necessary to replace, repair, or otherwise reestablish the right-of-way or private property and all features contained within it to the same or equal condition as it existed prior to any change or construction therein.
17. Right-of-Way - Land, property, or property interest, usually in a strip, acquired for or devoted to transportation purposes.
18. Shall - The word "shall" means "mandatory performance by the contracted party" to the task referred to and accompanying this word.
19. Site Entrance - The site entrance is the same as the construction entrance; refer to Construction Entrance definition for location.
20. Site Superintendent - Representative of the Contractor who shall be present on site during all Contractor activities and serve as principal point of contact, and

who will be responsible for directing and overseeing all aspects of Contractor's work.

21. Site/On Site - Any area on the Lake Calumet Cluster, Paxton I Landfill, or Paxton II Landfill property.
22. Snow Load – The snow load is thirty (30) psf for Winnebago County.
23. Staging Areas - Designated areas used by the Contractor for temporary or long-term storage of construction equipment, materials, soil or gravel stockpiles, landscaping elements, and other items necessary to complete the Work.
24. Subgrade – The top surface of the roadbed on which subbase, base, surfacing, pavement, or layers of similar materials are placed.
25. Subsurface Features - Manmade features below existing grade or water surface including, but not limited to: utilities, pipelines, drain lines and drains, wells, building foundations, footings, pilings, bridge piers, and riprap.
26. Support Areas - Areas approved for use by the Engineer that may be used by the Contractor for office and administrative functions, and parking of employee vehicles.
27. Utility - The privately, publicly, or cooperatively owned lines, facilities, and systems for producing, transmitting, or distributing communications, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, and storm-water, not connected with on-site drainage, and other similar commodities, including publicly owned fire and police signal systems and street lighting systems, which directly or indirectly serve the public or any part thereof. The term "utility" shall also mean the utility company, inclusive of any wholly owned or controlled subsidiary.
28. Wind Load – The wind load for Winnebago County is ninety (90) mph for a three (3) second burst and seventy-five (75) mph sustained.

## 1.3 NAME OF SITE

The name of the site is Beloit Corporation's Blackhawk Facility (the site), as is used in these Design Specifications.

## 2.0 PRODUCTS

[Not Used]

## 3.0 EXECUTION

[Not Used]

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

### 1.1 LOCATION OF WORK

The Beloit Corporation's Blackhawk Facility (the site) is located in Rockton Township in north-central Illinois. This National Priorities List (NPL, or Superfund) site occupies part of the northern half of Section 13 and the southeast quadrant of Section 12, T46N, R1E, Winnebago County, Illinois.

The site is bounded on the north by Prairie Hill Road, on the west by the Rock River, on the south by a line projected from the Rock River along the south edge of a Village of Rockton easement and access road (for the village water tower) to Blackhawk Boulevard, and on the east by Blackhawk Boulevard. The NPL site area includes the Beloit Corporation property, the neighboring Blackhawk Acres subdivision, the former Soterion/United Recovery facility (Soterion), a portion of the Taylor, Inc. property, and the Safe-T-Way property. A new property owner, Reload, Inc., uses the site as a transfer station for drywall and other building materials. Primary access to the site is as specified in Section 01005, ABBREVIATIONS AND DEFINITIONS.

### 1.2 GROUNDWATER ELEVATION

Groundwater depth is recorded to be approximately 25 feet below the elevation of the groundwater treatment building. This roughly corresponds to an elevation of 730 feet above mean sea level (MSL). The Rock River is also at an approximate elevation of 730 feet MSL. Table 01010-1, Groundwater Monitoring Well and Water Table Elevations lists all of the site monitoring and extraction wells with associated water table elevations.

### 1.3 BACKGROUND INFORMATION

The manufacturing facility formerly owned by the Beloit Corporation comprises the majority of the site. The Beloit Corporation is a former manufacturer of machines that produced layered paper products from paper pulp. The use of solvent for machine parts cleaning at the Beloit Corporation plant was identified as the source of groundwater contamination.

In June 1999, the Beloit Corporation filed for bankruptcy. In February 2002, EPA, the United States Department of Justice (DOJ), and Guiffre II, LLC, the new owner of the property located within the Beloit Corporation site, signed a settlement agreement under Section 122(h) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The State was also a party to and signed that agreement in April 2002. The new property owner uses the site as a transfer station for drywall and other building materials.

In the early 1980s, the Illinois EPA investigated United Recovery and private water supply wells located in the Blackhawk subdivision. The discovery of volatile organic compounds

(VOCs) [primarily tetrachloroethene (PCE) and 1,1,1-trichloroethane (1,1,1-TCA)] in residential groundwater led to subsequent groundwater quality studies and the inclusion of the Beloit Corporation site on the NPL. Pursuant to a consent decree, the Beloit Corporation was required to complete a RI/FS, which included the Beloit Corporation property.

During the RI, soil, soil gas, and groundwater quality data was gathered by Montgomery Watson Americas, Inc., consultant to the Beloit Corporation (Montgomery Watson 1999). Due to soil and groundwater concentrations of PCE in monitoring wells W23/W23B and W36C, the southern area of the Erection Bay is believed to be the source area for the On-Property Groundwater Plume. High levels of PCE in groundwater have been persistent at this location, despite implementation of the ISCA pump and treat (P&T) system and placement of an extraction well (EW01) in the vicinity. In the RI report, Montgomery Watson estimated the dimensions of the Erection Bay source area (groundwater VOCs in excess of 1,000 micrograms per liter [μg/L]) to be approximately 100 feet by 120 feet (12,000 square feet), and conservatively estimated that the plume in this area extends to a depth of 60 feet below ground surface (BGS).

Based on the RI, the Illinois EPA determined that the VOC contamination of groundwater originates on Beloit Corporation property and extends via a plume into the Village of Rockton and the southern portion of the Blackhawk Acres subdivision. A second plume, containing trichloroethene (TCE) and located deeper within the shallow aquifer, originates near the southeast corner of the Beloit Corporation property and extends into the village of Rockton. The source of the TCE plume could not be identified.

Based on the RI, the Illinois EPA determined that the VOC contamination of groundwater originates on Beloit Corporation property and extends via a plume into the Village of Rockton and the southern portion of the Blackhawk Acres subdivision. A second plume, containing trichloroethene (TCE) and located deeper within the shallow aquifer, originates near the southeast corner of the Beloit Corporation property and extends into the village of Rockton. The source of the TCE plume could not be identified.

Based on the RI and BLRA, chemicals of concern (COCs) at the Beloit Corporation NPL site are chlorinated VOCs in groundwater and soil. The VOCs in groundwater on and around the site are distributed into three plume categories that incorporate the five separate areas of VOCs identified in the RI report. These three areas and plumes are as follows:

**Groundwater VOC Source Area** – On the Beloit Corporation property near the current location of the Erection Bay.

**On-Property Groundwater Plume** – On the Beloit Corporation property. This plume includes all the VOC-contaminated groundwater detected in the central portion of the Beloit Corporation property.

**Off-Property Groundwater Plumes** – Off the Beloit Corporation and NPL site boundaries. This off-property area includes the following groundwater plumes and areas of VOC groundwater contamination, as described in the RI: TCE plume; the portion of the on-property Groundwater Plume that extends south of the NPL site into the Village of Rockton; and southern Blackhawk Acres subdivision wells.

In November 2001, the final feasibility study (FS) that discusses and compares the potential cleanup remedial alternatives was completed by the Beloit Corporation. The Illinois EPA conditionally approved the final FS in January 2002.

In 1993, the Illinois EPA installed point-of-entry carbon filtration units in residences with impacted wells in the Blackhawk Acres subdivision. The Illinois EPA currently maintains and monitors these systems. The ISCA P&T system was installed in 1996 by Beloit Corporation, with the approval of the Illinois EPA. The system consists of five extraction wells and an air-stripping tower located in the southeastern corner of the Beloit Corporation property. The system is designed to contain groundwater within the Beloit Corporation property and provide treatment of extracted groundwater by air stripping. Treated groundwater is discharged to the Rock River under a National Pollutant Discharge Elimination System (NPDES) permit, at an outfall located on Beloit property. The VOC groundwater plumes in the Village of Rockton and the Blackhawk Acres subdivision have been naturally attenuating since the ISCA P&T system was implemented.

Bodine Environmental Services, Inc. (BES), a State Procured Corrective Action Contractor (CAC), is responsible for long-term groundwater monitoring and O&M associated with the existing ISCA P&T system. Groundwater monitoring is performed quarterly pursuant to the Action Memorandum for the ISCA and the Removal Action Design Report, both of which are part of the Administrative Record for the site.

Reports generated to date are detailed in Section 01011, PREVIOUS STUDIES.

## 1.4 SCOPE OF WORK

A. ALL WORK STATED WITHIN THIS SECTION OR TO MAKE A COMPLETE AND WORKABLE SYSTEM SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND DESIGN DRAWINGS.

B. Construction of three (3) groundwater extraction wells with tie-in to the ISCA P&T system. Construction of each extraction well will require the following:
   1. Boring to depth to prepare for fracturing;
   2. Fracturing the open borehole across the specified intervals;
   3. Re-drilling the fractured borehole;
   4. Redeveloping the fractures;
   5. Installation of the extraction well and components;
   6. Developing the extraction well after completion;
   7. Trenching for force main (FM) and electrical service;
   8. Providing for acceptable trench base material;

9. Installation of FM with associated appurtenances;
10. Installation of electrical service to the extraction wells
11. Installation of header pipe within treatment building;
12. Installation of spare FM stub-ups and electrical stub-ups; and
13. Labeling of the extraction wells, EW05, EW06, and EW07, and spares, as shown on the Design Drawings.

C. Construction of a metal building to house new components. Construction of the building will include:
1. Earthwork for preparation of footings and slab-on-grade construction, including sump pit;
2. Construction of the metal building and wall and roofing tie-ins to the existing ISCA P&T metal building;
3. Man door installation to the existing ISCA P&T metal building;
4. Overhead door installation for outdoor access; and
5. Installation of insulation, interior lighting, heater, vent fan, and other building materials and components as required.

D. Re-routing of electrical conduit for man door installation.

E. Installation of equalization tank with transfer pump, level switch, roof vent, and associated appurtenances.

F. Re-plumbing of existing interior pipe to remove manifold system and connect all FMs individually to the equalization tank.

G. Re-plumbing of existing interior pipe from the new transfer pump to the Turbostripper.

H. Upgrade of the Control Panel.

I. Programming of the programmable logic controller (PLC) to include additional system components.

J. Construction and development of groundwater monitoring wells (MWs).

K. Selected well abandonment.

L. Miscellaneous debris disposal.

M. Health and safety plan to govern activities as outlined in the Specifications.

N. Site security for the protection of equipment and materials stored on site.

O. Site survey following construction activities.

P. Obtaining the permits required for Work.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

**Table 01010-1:**
**GROUNDWATER MONITORING WELL AND WATER TABLE ELEVATIONS**

| Well ID | Location | | TOC Elev. | September 25. 2006 | | January 01, 2007 | |
|---|---|---|---|---|---|---|---|
| | Northing | Easting | | Depth to Water | Water Elev. | Depth to Water | Water Elev. |
| W1R | | | 749.41 | 20.49 | 728.92 | 20.20 | 729.21 |
| W2 | | | 755.03 | 30.88 | 724.15 | 28.99 | 726.04 |
| W3R | | | 764.25 | 24.80 | 721.45 | 24.06 | 722.19 |
| W5R | | | 746.16 | 25.25 | 720.91 | 24.81 | 721.55 |
| W6 | | | 747.79 | 22.53 | 725.26 | 21.49 | 726.30 |
| W7 | | | 751.29 | 21.98 | 729.31 | 21.78 | 729.51 |
| W8R | | | 774.93 | 44.17 | 730.76 | 44.70 | 730.23 |
| W9 | | | 754.76 | 25.8 | 728.96 | 25.73 | 729.03 |
| W10 | | | 754.74 | 25.75 | 728.99 | 25.68 | 729.06 |
| W11R | | | 774.92 | 44.15 | 730.77 | 44.68 | 730.24 |
| W12R | | | 756.56 | 34.19 | 722.37 | 33.55 | 723.01 |
| W13 | | | 752.90 | Damaged | - | Damaged | - |
| W14 | | | | Damaged | - | Damaged | - |
| W15 | | | | " | | Damaged | - |
| W16R | | | 761.59 | 31.80 | 729.79 | 31.94 | 729.65 |
| W17 | | | 735.57 | 9.67 | 725.90 | 8.57 | 727 |
| W18 | | | 748.48 | 25.67 | 722.81 | 24.96 | 723.52 |
| W19 | | | 744.74 | 23.47 | 721.27 | 22.84 | 721.90 |
| W19B | | | 744.72 | 23.44 | 721.28 | 22.83 | 721.89 |
| W20R | | | 746.56 | 23.73 | 722.53 | 23.03 | 723.53 |
| W20B | | | 747.08 | 24.50 | 722.58 | 23.82 | 723.26 |
| W21 | | | 750.23 | 26.57 | 723.66 | 25.96 | 724.27 |
| W22 | | | 757.90 | 33.31 | 724.59 | 31.04 | 726.86 |
| W22B | | | 758.05 | 33.91 | 724.14 | 32.35 | 725.70 |
| W22C | | | 757.69 | 34.18 | 723.51 | 33.13 | 724.56 |
| W23 | | | 753.52 | 25.80 | 727.72 | 26.85 | 726.67 |
| W23B | | | 753.70 | 25.89 | 727.43 | 27.05 | 726.27 |
| W25C | | | 746.76 | 25.72 | 721.04 | 25.06 | 721.70 |
| W26 | | | 754.16 | 33.70 | 720.46 | 33.3 | 720.86 |
| W26C | | | 754.61 | 34.90 | 719.71 | 34.43 | 720.18 |
| W27 | | | 767.29 | 38.56 | 728.73 | 38.60 | 728.69 |
| W28 | | | 752.43 | 22.31 | 730.12 | 22.36 | 730.07 |
| W29 | | | 751.16 | 28.38 | 722.78 | 28.27 | 722.89 |
| W29C | | | 747.90 | 24.10 | 723.80 | 23.97 | 723.93 |
| W31C | | | 753.75 | 25.57 | 728.18 | 25.38 | 728.37 |
| W32 | | | 756.54 | 28.17 | 728.37 | 27.93 | 728.61 |
| W34 | | | 753.45 | CNL | - | CNL | - |

| Table 01010-1: GROUNDWATER MONITORING WELL AND WATER TABLE ELEVATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Well ID | Location | | TOC Elev. | September 25, 2006 | | January 01, 2007 | |
| | Northing | Easting | | Depth to Water | Water Elev. | Depth to Water | Water Elev. |
| W35C | | | 754.01 | 25.61 | 728.40 | 25.34 | 728.67 |
| W37 | | | 757.68 | 28.55 | 729.13 | 28.70 | 728.98 |
| W38 | | | 745.26 | 21.85 | 723.41 | 21.17 | 724.09 |
| W39 | | | 753.85 | CNL | CNL | - | - |
| W40 | | | 753.68 | 24.95 | 728.73 | 24.92 | 728.76 |
| W41 | | | 754.38 | 27.73 | 726.65 | 27.31 | 727.07 |
| W42 | | | 749.68 | 21.85 | 727.83 | 20.22 | 729.46 |
| W43C | | | 748.03 | 27.53 | 720.50 | 27.12 | 720.91 |
| W44C | | | 746.80 | 21.69 | 725.11 | 21.44 | 725.36 |
| W45 | | | 756.37 | 33.89 | 722.48 | 32.85 | 723.52 |
| W46 | | | 748.39 | 27.38 | 721.01 | 26.76 | 721.63 |
| W47C | | | 739.37 | 20.30 | 719.52 | 19.85 | 719.52 |
| W48C | | | 739.19 | 21.71 | 717.48 | 21.17 | 718.02 |
| W49C | | | 755.5 | 37.45 | 718.10 | 37.04 | 718.51 |
| W50C | | | 747.57 | 25.87 | 721.70 | 25.72 | 721.85 |
| W51C | | | 757.07 | 35.54 | 721.53 | 35.06 | 722.01 |
| G101 | | | 766.45 | DRY | < 715.15 | DRY | ≤ 715.15 |
| G103S | | | 748.94 | 24.98 | 723.96 | 24.04 | 724.90 |
| G103D | | | 747.96 | 24.08 | 723.88 | 23.15 | 724.81 |
| G104 | | | 744.64 | 22.80 | 721.84 | 22.04 | 722.60 |
| G107 | | | 771.31 | 41.45 | 729.86 | 41.64 | 729.67 |
| G108S | | | 756.90 | 36.35 | 720.55 | 36.26 | 720.64 |
| G108D | | | 756.34 | 35.79 | 720.55 | 35.70 | 720.64 |
| G109 | | | 739.05 | Obstruction @ 2.95 | - | Obstruction @ 2.95 | - |
| G110 | | | 738.26 | Abandoned | - | Abandoned | - |
| P1 | | | - | NR | Riser Broken | NR | Riser Broken |
| EW01 | | | 755.63 | 29.79 | 725.84 | 48.66 | 706.97 |
| EW02 | | | 757.49 | 32.30 | 725.19 | 31.48 | 726.01 |
| EW03 | | | 746.15 | 27.88 | 718.27 | 27.14 | 719.01 |
| EW04 | | | 752.68 | 38.01 | 714.67 | 37.37 | 715.31 |

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section contains a list of reports from previous studies performed at the Beloit site.

### 1.2 PREVIOUS STUDIES

A. Ecology and Environment Engineering, Inc. (EEEI), 2007, *Remedial Action 30% Design Report, Beloit Corporation Superfund Site, Rockton, Illinois*, April 2007.

B. Ecology and Environment, Inc. (E & E), 2007, *Technical Memorandum, Source Area Investigation, Beloit Corporation Superfund Site, Rockton, Illinois*, February 2007.

C. E & E, 2006, *Remedial Design Work Plan, Beloit Corporation Superfund Site, Rockton, Illinois*, July 2006.

D. Illinois Environmental Protection Agency (Illinois EPA), 2004, *Illinois EPA Superfund Record of Decision, Beloit Corporation IEPA ID: L 2010355004 Rockton, Illinois*, September 2004.

E. Montgomery Watson Americas, Inc. (Montgomery Watson), 1999, *Remedial Investigation Report, Beloit Corporation, Blackhawk Facility, Rockton, Illinois*, July 1999.

F. Montgomery Watson, 1996, *Removal Action Design Report, Beloit Corporation-Blackhawk Facility, Rockton, Illinois*, April 1996.

G. Montgomery Watson, 1996, *Construction Observation Report, Beloit Corporation-Blackhawk Facility, Rockton, Illinois*, May 1996.

H. Montgomery Watson, 1996, *Operation, Maintenance, and Monitoring Manual, Beloit Corporation-Blackhawk Facility, Rockton, Illinois*, May 1996.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

### 1.1 WORK HOURS

A. Working Days/Hours shall be Daylight Hours, Monday through Friday, unless otherwise approved by the Agency. No work shall occur except between the hours of 7:00 A.M. and 6:00 P.M. No deliveries shall be scheduled before 7:00 A.M. or after 6:00 P.M., and delivery trucks shall not be allowed to wait outside the site entrance before or after hours. Work on Saturday and Sundays, if approved, shall start no earlier than 7:00 A.M.

B. It is expected that the Contractor will work <u>at least</u> forty (40) hours per week, either five (5) days at eight (8) hours each or four (4) days at ten (10) hours each.

C. The noise (and lights if night work is approved) will impact residents near the site of the work. Levels of noise (and possibly light) will be major criteria used by the Agency to determine if work beyond the hours specified above will be allowed.

D. The Engineer shall be present whenever on-site work, as defined in Supplemental General Conditions, is being performed.

E. At the preconstruction conference, the Contractor shall establish the work hours schedule. The Contractor shall not change the work hours without giving one (1) week's notice to the Engineer, with copies to the Agency's Project Manager and the Agency's Authorized Representative.

## 2.0 PRODUCTS

[Not Used]

## 3.0 EXECUTION

[Not Used]

*** END OF SECTION ***

Note: This page intentionally left blank.

SECTION 01220
DISSEMINATION OF PROJECT INFORMATION

## 1.0 GENERAL

### 1.1 SCOPE

A. This section covers mandatory requirements concerning release of project information.

B. All Contractor personnel, subcontractor personnel, and suppliers shall be made aware of the requirements of this section.

### 1.2 REFERENCES

[Not Used.]

### 1.3 ROLE OF THE AGENCY AND ENGINEER

A. The Agency will have responsibility for disseminating project information to local, state, and federal public agencies.

B. The Contractor shall refer any substantive questions to the Engineer.

C. In particular, the following data are to be considered confidential and shall not be released by anyone except the Agency:

1. Results of any tests.
2. Interpretation of any test results.
3. Changes to the Contract.
4. Any hazard or risk assessment.
5. The rationale for, or requirements of, the project or any of its components.
6. Identification of any cultural resources.

### 1.4 ROLE OF THE CONTRACTOR

A. Any substantive questions from property owners; federal, local, or other state agencies; tribes; or the general public, and <u>any questions from any news media</u> shall be referred to the Agency.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

## 1.1 SUMMARY

A. The purpose of the preconstruction meeting is to review Contract requirements; establish a detailed schedule of operations; discuss the Contractor's safety rules and regulations and the Contractor's Site Safety Plan; discuss material handling; discuss the transportation and disposal plan; introduce various members of the Contractor's, Agency's, and Engineer's staffs; and resolve any questions raised by any party.

B. The purpose of project meetings is to update the job progress, update cost estimates for work accomplished, review submittals log, review requests for payment, resolve problems that may arise, discuss any accidents or near accidents since the last meeting, and address any other matters of concern to any party.

## 1.2 REFERENCE STANDARDS

[Not used.]

## 1.3 NATURE OF MEETINGS

A. The meetings specified herein are formal in nature and should be attended by both the Contractor's and Engineer's project managers and the key technical personnel. Agency personnel may also attend these meetings.

B. Unless requested otherwise by the Engineer, the Contractor's overall superintendent (primary site representative) should attend preconstruction and project meetings.

C. Nothing in this section should preclude the usual informal meetings held daily between the Contractor's and Engineer's staffs.

## 1.4 DOCUMENTATION

A. The Engineer shall prepare a summary of each meeting within three (3) days following the meeting, especially noting any decisions made, and shall deliver a copy of same to the Contractor and the Agency.

B. The Contractor shall review the summary of the meeting and immediately inform the Engineer if it believes the summary is not completely accurate. Failure to inform the Engineer of any inaccuracies within ten (10) calendar days of the meeting shall indicate the Contractor's concurrence with the summary of the meeting.

## 1.5 SCHEDULING MEETINGS

A. The preconstruction meeting shall be scheduled by the Engineer shortly after the formal Award of Contract.

B. Project meetings shall be held on the construction site at a minimum of once per week. Before project construction begins a day and time shall be agreed upon on which the meetings shall take place each week.

C. Either party, with adequate advance notice, may request a meeting not otherwise scheduled.

## 1.6 LOCATION OF MEETINGS

A. The Engineer will arrange for the location of the preconstruction meeting.
B. Normally all other meetings will occur at the site field office.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. Prepare a detailed construction schedule for the site work with sub-schedules of related activities that are essential to the construction process.

B. Update and revise the detailed construction schedule on a weekly basis and as requested by the Engineer.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.

### 1.3 REFERENCE STANDARDS

[Not used.]

### 1.4 SUBMITTALS

A. Submit the detailed construction schedule to the Engineer and Agency within twenty-eight (28) calendar days after Notice to Proceed.

B. Submit revised weekly progress schedules to the Engineer and Agency for review after Engineer's approval of the initial construction schedule.

### 1.5 FORM OF SCHEDULES

A. Prepare Construction Progress and submittal schedules in the form of a critical path method horizontal bar chart.
   1. Provide separate horizontal bar for each trade or operation within each structure or activity.
   2. Horizontal time scale: In days from start of construction.
   3. Scale and spacing: To allow space for notations and future revisions.

### 1.6 CONTENT OF SCHEDULES

A. Construction Progress Schedule:
   1. Show the complete sequence of construction by activity.
   2. Show the dates for the beginning of, and completion of, each activity, including major milestones.
   3. Show projected percentage of completion for each item, as of the first day of each week.
   4. Identify key activities for subcontractors.
   5. Show calendar days, as well as on-site field days.

B. Submittals Schedule in accordance with Section 01330, CONTRACTOR SUBMITTALS. Show:

1. The dates for Contractor's submittals; and
2. The dates that submittals were approved by the Engineer.

C. A typewritten list of all long-lead items (equipment, materials, etc.).

## 1.7 SCHEDULE REVISIONS

A. Indicate progress of each activity up to the date of submission.

B. Show changes occurring since previous submission of schedule:
   1. Major changes in scope.
   2. Activities modified since previous submission.
   3. Revised projections of progress and completion.
   4. Other identifiable changes.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 REQUIREMENTS

A. The Contractor shall submit to the Engineer for review all plans, shop drawings, test reports, data on materials and equipment, and material samples required for the proper control of the Work.

B. The Contractor shall note that there are specific requirements for submittals to the Engineer and/or Agency in other sections of these Specifications, specifically:

1. Section 01320 – Construction Schedules.
2. Section 01340 – Construction Operations Plan.
3. Section 01350 – Contractor Site Safety Plan.
4. Section 01450 – Quality Control.
5. Section 01510 – Temporary Construction Trailer.
6. Section 01520 – Temporary Utilities.
7. Section 01570 – Control and Regulation of Traffic.
8. Section 01610 – Construction Aids.
9. Section 02040 – Surveying.
10. Section 02100 – Mobilization and Site Preparation.
11. Section 02111 – Excavation and Handling of Contaminated Material.
12. Section 02220 – Demolition.
13. Section 02300 – Earthwork.
14. Section 02410 – Transportation.
15. Section 02420 – Off-Site Disposal.
16. Section 02910 – Demobilization.
17. Section 03300 – Cast-in-Place Concrete.
18. Section 15050 – Basic Materials and Methods for Piping.

C. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting.

### 1.2 RELATED WORK

A. In addition to the requirements for submittals to the Engineer described in this section, Contractor is also responsible for submittals to local, state, and federal agencies that may be needed for completion of the Work.

### 1.3 SHOP DRAWINGS

A. When used in the Contract Documents, the term "shop drawings" shall be considered to mean Contractor's plans for material and equipment, which become an integral part of the Project. <u>It should be noted that no work will be allowed to proceed until shop drawings have been received, reviewed, and approved by the Engineer and/or the Agency</u>. These drawings shall be complete and detailed. Shop drawings shall consist of fabrication, erection, and setting drawings and schedule drawings, manufacturer's scale drawings, bills of material, and inspection and test reports including performance curves and certifications as applicable to the Work.

B. All details on shop drawings submitted for approval shall show clearly the elevations of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements; such measurements shall be made and noted on the shop drawings before being submitted for approval.

## 1.4 PRODUCT DATA

A. Product data as specified in individual sections, includes, but is not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliance and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, and printed product warranties, as applicable to the Work.

## 1.5 SAMPLES

A. The Contractor shall furnish, for the approval of the Engineer, samples required by the Contract Documents or requested by the Engineer. Samples shall be delivered to the Engineer as specified or directed and in quantities and sizes as specified. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in the Work until approved by the Engineer.

B. The Contractor shall prepare a transmittal letter for each shipment of samples. He shall enclose a copy of this letter with the shipment. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.

## 1.6 SUBMITTAL REQUIREMENTS

A. The Contractor shall review, approve, and submit, with reasonable promptness so as to cause no delay in the Contract Work or in the Work of the Agency or any separate contractor, all submittals as may be required.

B. The Contractor shall submit four (4) copies of all Submittals. The Engineer will retain one (1) set, forward two (2) sets to the Agency, and return one (1) set to the Contractor with appropriate review comments. The Engineer will review the submittal and return to the Contractor the set of marked-up copies with appropriate review comments.

C. All submittals shall be made directly to the Chicago office of the Engineer.

D. Plans, shop drawings, and samples shall be furnished with the following information:
1. Title.
2. Date.
3. Name of contractor, subcontractor, and manufacturer submitting information.
4. Clear identification of contents, location of the Work, and the specification section numbers where the product is referred to in the Contract Documents.
5. Contractor Certification Statement as defined below.
6. Submittal Identification Number.
7. Contract Drawing Number Reference (if applicable).

E. In accordance with subparagraph 1.6.A, Submittal Requirements, each plan, shop drawing, sample, and catalog data submittal from the Contractor shall have affixed to it the following Certification Statement, signed by the Contractor to verify Contractor review and approval: "Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers, and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contractor requirements."

F. Items specified are not necessarily intended to be a manufacturer's standard product. Variations from specified items will be considered on an "or equal" basis. If submittals show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal and on the shop drawings along with notification of his intent to seek contract adjustment. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such drawings have been reviewed. Variations submitted but not described may be cause for rejection. Any variations initiated by the Contractor will not be considered as an addition to the scope of Work unless specifically noted and then approved as such in writing by the Engineer.

G. Data on materials and equipment shall include materials and equipment lists giving, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, material, size, finish, and all other pertinent data.

H. All submittals shall be made on the form provided, Table 01330-1.

## 1.7 CONTRACTOR'S RESPONSIBILITY

A. It is the duty of the Contractor to check, and coordinate with the work of all trades, all drawings, data, schedules, and samples prepared by or for him before submitting them to the Engineer for review. Each and every copy of any drawing or data sheet larger than eleven by seventeen (11x17) inches shall bear Contractor's Certification Statement showing that they have been so checked and approved. Drawings or data sheets eleven by seventeen (11x17) inches and smaller shall be bound together in an orderly fashion and bear the Contractor's Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a list of all sheet numbers within the package. Shop drawings submitted to the Engineer without the Contractor's Certification Statement will be returned to the Contractor, without review at the Engineer's option, for nonconformance with this requirement.

B. The Contractor shall review shop drawings, product data, and samples prior to submission to determine and verify the following:
   1. Field measurements.
   2. Field construction criteria.
   3. Manufacturer's catalog numbers and similar data.
   4. Conformance with Specifications.

C. Shop drawings shall clearly indicate any deviations or variations in the submittal from the requirements of the Contract Documents.

D. Within fourteen (14) days after the Date of the Notice to Proceed, the Contractor shall furnish the Engineer a Submittal Schedule fixing the respective dates for the initial submittals, testing, and installation of materials, supplies, and equipment as applicable. The Contractor shall prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work sections of the Specifications, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit complete and acceptable submittals sufficiently in advance of the Work.

E. The Contractor shall not begin any work affected by a submittal returned "*not approved*" until a revision or correction of the submittal has been resubmitted and returned "*approved*" or "*approved as noted.*" Any corrections made to the submittals are to be followed without exception.

F. The Contractor shall submit to the Engineer all shop drawings and data sufficiently in advance of construction requirements to provide no less than twenty-one (21) calendar days for review from the time the Engineer receives the submittals.

G. The Contractor shall be responsible for and bear all costs of damages that may result from the ordering of any material or from proceeding with any part of Work prior to the review and approval by Engineer of the necessary submittals.

H. All shop drawings, product data, and samples submitted by subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission according to the approved submittal schedule so as to prevent delays in delivery of materials and project completion.

I. The Contractor shall check all subcontractor's shop drawings, product data, and samples regarding measurements, size of members, materials, and details to satisfy himself that the documents are in conformance with the Contract Documents. Submittals found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission to the Engineer.

## 1.8 ENGINEER'S REVIEW OF SUBMITTALS

A. The Engineer has twenty-one (21) days for review starting on the date of receipt of submittals.

B. The Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Documents or from departures therefrom. The Contractor remains responsible for details and accuracy, for coordinating the Work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

C. The review of Contractor submittals will be general and shall not be construed:
   1. As permitting any departure from the Contract requirements;
   2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials; or
   3. As approving departures from details furnished by the Engineer, except as otherwise provided herein.

D. If the submittals describe variations and show a departure from the Contract requirements that the Engineer finds to be in the interest of the Agency and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

E. Approval/disapproval designations for submittals will be identified by the Engineer.

F. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer on previous submissions. Any such revisions that are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any work done because of this type of revision that is not in accordance with the Contract Documents as may be required by the Engineer.

G. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer and Agency at least seven (7) working days prior to release for manufacture.

H. When the plans and shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

I. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Incomplete submittals will be returned to the Contractor. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

Table 01330-1

| TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE | DATE | TRANSMITTALL NO. |
|---|---|---|
| | DATE | 1 |

**SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS** (This section will be initiated by the contractor)

| TO: | FROM: | CONTRACT NO. | CHECK ONE: |
|---|---|---|---|
| **Ecology and Environment Engineering, Inc.**<br>**33 North Dearborn**<br>**Chicago, IL 60602**<br>**Attn: Enter Engineer Name** | **Contractor**<br>**Street Address**<br>**City State**<br>**Contact Phone Number** | **Beloit Site** | ☐ THIS IS A NEW TRANSMITTAL<br>☐ THIS IS A RESUBMITTAL OF TRANSMITTAL ______ |
| SPECIFICATION SEC. NO. (Cover only one section with each transmittal) 02630 | PROJECT TITLE AND LOCATION<br>**Beloit Site, Rockton, IL** | | CHECK ONE: THIS TRANSMITTAL IS<br>☐ FIO ☐ FOR GOV'T APPROVAL |

| ITEM NO.<br>a. | DESCRIPTION OF ITEM SUBMITTED (Type size, model numbers / etc.)<br>b. | MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction no. 8)<br>c. | NO. OF COPIES<br>d. | CONTRACT REFERENCE DOCUMENT: SPEC. PARA NO.<br>e. | CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO<br>f. | FOR CONTRACTOR USE CODE<br>g. | VARIATION (See instructions No.6)<br>h. | FOR CE USE CODE<br>i. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| 1 | ITEM | MFG. | # | # | # | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| | | | | | | | | |

COMMENTS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated

Name ______________________

NAME AND SIGNATURE OF CONTRACTOR

**SECTION II - APPROVAL ACTION**

APPROVAL COMMENTS

See Approval Comments, below

NAME, TITLE AND SIGNATURE OF APROVING AUTHORITY

☐ Approved
☐ Approved as Noted
☐ Revise and Resubmit
☐ Not Approved
☐ Other______________

**Review and Approval** is only for conformance with the design concepts of the project and compliance with the information given in the **Contract Documents**. Contractors is responsible for dimensions to be confirmed and correlated at the job site for information that portains solely to the fabrication process or to the means and methods of construction; and for coordination of the work of all trades.

**ecology and environment engineering, Inc.**

NAME, EEEI Site Manager ______________________ Date: ______________

SHEET 1 OF 1

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## 1.0 GENERAL

### 1.1 REQUIREMENTS

A. The Contractor shall provide to the Engineer and Agency a Construction Operations Plan (COP). The COP shall identify personnel, equipment, construction procedures, and construction quality control to be used in carrying out the requirements of this project. Site work will not be initiated until the COP has been approved by the Engineer.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.

### 1.3 CONTENTS OF THE COP

A. The COP shall outline the overall construction sequencing and procedures to be followed during the site work activities. The plan shall contain a thorough and concise summary of how the Work will be accomplished, and shall include at a minimum:

1. *Technical Approach.* The technical approach shall include general work procedures and means and methods to accomplish all Work activities discussed in the technical specifications.
2. *Quality Control/Quality Assurance.* The Contractor shall describe the general quality control and quality assurance procedures, methods, and tests to be implemented to achieve compliance with the project requirements, plans, and specifications described herein.
3. *Construction Operations Organization Chart.* This chart shall show lines of authority and responsibility. Number of personnel to be utilized on the job shall be indicated in appropriate organizational elements. If significant changes in the organization are expected to occur during the life of the project or phases of construction, these shall be discussed.
4. *Personnel Qualifications.* Names, qualifications, and work experience of all Contractor supervisors, health and safety personnel, and employees with Quality Control responsibilities shall be provided. If the personnel identified in the COP are not available at the start of the project, the Contractor shall submit, prior to mobilization, the names and qualifications of substitute personnel, with equal or more extensive experience, to the Engineer for approval.
5. *Equipment to be Utilized for the Site Activities.* All equipment to be used to complete the site work activities shall be described. In addition, the Contractor shall include maintenance, repair, and fueling procedures to be employed to ensure optimal equipment operation.
6. *Regulatory Requirements.* Regulatory requirements applicable to the project and how compliance will be assured shall be addressed. Personnel training requirements shall be listed and compliance demonstrated.

7. *Lower Tier Contractors.* Subcontractors for all work to be subcontracted by the Contractor must be identified as well as their proposed Subcontractors.

## 1.4 SUBMITTALS

A. Within twenty-eight (28) calendar days following Notice to Proceed, the Contractor shall provide the Engineer with two (2) copies of the completed COP for review and acceptance.

## 1.5 NOTIFICATION OF CHANGE

A. Following acceptance of the COP, the Contractor shall propose revisions to the COP at any time that the procedures or processes differ from those stated in the previously approved COP. These proposed revisions must be submitted to the Engineer, with adequate time for approval, prior to the change being instituted. The Engineer's review and subsequent approval or disproval for any version of the COP shall follow the procedures outlined in Section 01330, CONTRACTOR SUBMITTALS.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. Develop and submit a Contractor Site Safety Plan (CSSP). An existing Site Safety Plan has been developed by the Engineer and is available for reference. Note that the Engineer's Site Safety Plan has been developed for the sole use of the Engineer. Contractor is responsible for developing and implementing his/her own safety plan.

B. Plan for and ensure that all personnel comply with the basic provisions of the Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1910) and General Construction Standards (29 CFR 1926). Have a hazard communication program in place meeting OSHA 29 CFR 1910.120. The responsibility for the development, implementation, and enforcement of the health and safety requirements lies solely with the Contractor. Take all necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury, or loss to:
1. All personnel on the Work site.
2. All the Work and all materials or equipment to be incorporated in the work area, whether on or off the site.
3. Other property at or adjacent to the project site.
4. The general public on or off the work site when hazards are created by the Contractor's operations.

C. Construction operations under this Contract require work in an environment where contact with hazardous chemicals could possibly occur. Provide adequate protection for all personnel on site. Prepare a CSSP for all personnel working or visiting the site. Specific details of the minimum requirements of the CSSP are established herein.

### 1.2 RELATED WORK

A. Inclusive of all Sections.

B. Section 01330 – Contractor Submittals.

### 1.3 FORMAT OF THE CSSP

A. Develop a CSSP in the format specified below addressing, at a minimum, all the items specified herein. Require any employee or subcontractor personnel to read and abide by the CSSP.

B. The format of the CSSP shall be as follows:
1. Introduction
   a. Requirements are specified in Subpart 15 of this section.
2. Section A - Key Personnel and Alternates
   a. Requirements are specified in Subpart 1.7 of this section.
3. Section B - Job Tasks or Operations and Related Health and Safety Hazards, Levels of Protection, Air Monitoring, and Health Analysis.
   a. Requirements are specified in Subparts 1.9, 1.16, and 1.17 of this section.

4. Section C - Employee Training
   a. Requirements are specified in Subpart 1.8 of this section.
5. Section D - Personal Protective Equipment.
   a. Requirements are specified in Subpart 1.10 of this section.
6. Section E - Medical Surveillance
   a. Requirements are specified in Subpart 1.6 of this section.
7. Section F - Monitoring Requirements
   a. Requirements are specified in Subpart 1.12 of this section.
8. Section G - Site Security and Control
   a. Requirements are specified in Subpart 1.14 of this section.
9. Section H - Decontamination - Equipment and Personnel
   a. Requirements are specified in Subpart 1.11 of this section.
10. Section I - Standard Operating Procedures, Recordkeeping, and Reporting
    a. Requirements are specified in Subpart 1.15 of this section.
11. Section J - Contingency Plan
    a. Requirements are specified in Subpart 1.13 of this section.

## 1.4 SUBMITTALS

A. Four copies of the CSSP shall be submitted to the Engineer for review within fourteen (14) days of receiving Notice to Proceed.

B. Daily air monitoring results shall be submitted to the Engineer at the end of each workday.

C. Hot Work permits and Confined Space Entry permits shall be submitted to the Engineer at the end of each workday.

D. Any other permits or monitoring results shall be submitted to the Engineer at the end of each workday.

## 1.5 INTRODUCTION (TO THE CSSP)

A. The following information shall be included in the introduction to the CSSP:
   1. Date prepared.
   2. Persons preparing the CSSP.
   3. Site location.
   4. Name and telephone number of Contractor's Project Manager.
   5. Name and telephone number of Contractor's Site Superintendent.
   6. Name and telephone number of Contractor's employee responsible for site safety.

B. The introduction to the CSSP shall also contain a brief description of the site, including general site background information, and a brief description of planned field activities.

## 1.6 MEDICAL SURVEILLANCE (SECTION E OF THE CSSP)

A. Follow guidelines established for medical surveillance as outlined in 29 CFR 1926.65.

B. Any employee who develops a work-related time-loss illness or injury during the period of the Contract shall be evaluated by the Contractor's physician prior to being allowed to reenter the work site.

## 1.7 KEY PERSONNEL (SECTION A OF THE CSSP)

A. Provide name(s) and duties of individual(s) who are responsible for implementing and overseeing the CSSP.

## 1.8 EMPLOYEE TRAINING (SECTION C OF THE CSSP)

A. For work areas that involve potential contact with, or potential exposure to, potentially hazardous materials, including but not limited to excavation and handling of soils and refuse; trenching; and dust generating activities, provide staff who have successfully completed a classroom occupational hazards training program and other training that meets or exceeds the requirements of OSHA 1926.65.

B. For work areas that involve potential contact with or potential exposure to asbestos-containing materials, provide staff who have successfully completed a classroom training program that meets or exceeds the requirements of 29 CFR 1926.58 and 1910.134.

C. The Contractor shall be responsible for training all personnel entering the site in order to make them aware of site-specific hazards and to explain emergency procedures and the use of protective gear required.

D. Require that any person employed on the site read the CSSP.

## 1.9 WORK AREAS (SECTION B OF THE CSSP)

A. Establish work areas and exclusion requirements consistent with the operations being performed and with monitoring results, as specified hereinafter.

B. The Contractor shall provide safe coordination of heavy equipment and machinery movement in all work areas.

C. To provide adequate traffic control prior to the start of work, the CSSP shall describe provisions for minimizing hazards to the Contractor's equipment and to the public that include:

1. Separating the public from the construction roads and work areas by means of detours, if necessary.
2. Keeping to a minimum the number of points where construction equipment crosses public streets.
3. Installing all signs prior to their actual need.
4. Removing all signs when they are no longer needed.

5. Ensuring that road grime, parked vehicles, stockpiled materials, etc., do not obscure signs.
6. Inspecting all signs to ensure they are properly maintained.
7. Selecting and training flagmen.
8. Complying with applicable laws.
9. Minimizing inconvenience to local residents and the general public.

D. All traffic control signs or devices used for protecting construction work should conform to United States Department of Transportation, Federal Highway Administration, "Manual on Uniform Traffic Control Devices," Millennium Edition (as amended) and Illinois Department of Transportation requirements.

## 1.10 PERSONAL PROTECTION REQUIREMENTS AND METHODS (SECTION D OF THE CSSP)

A. All personnel on site shall comply with general OSHA Construction Regulations (29 CFR 1926).

## 1.11 PERSONNEL AND EQUIPMENT DECONTAMINATION (SECTION H OF THE CSSP)

A. All personnel on site shall comply with general OSHA Construction Regulations (29 CFR 1926).

## 1.12 MONITORING REQUIREMENTS (SECTION F OF THE CSSP)

A. On-Site Air Monitoring by Contractor

1. For the health and safety of the Contractor's employees, on-site air quality monitoring shall be conducted by the Contractor at the start of each new activity to characterize the degree of exposure from each specific operation and for suspected major contaminants. Requirements for continuous or periodic monitoring shall be determined based on the knowledge of the air contaminants, and operational and physical stressors at the site. An air monitoring plan that dictates air sampling frequencies, strategies, and protocols shall be submitted as part of the CSSP. It is important that the plan include real-time monitoring so that data is immediately available for site safety decisions. A description of monitoring techniques and equipment shall be included in the CSSP. Monitoring shall meet, at a minimum, the requirements of 29 CFR 1926.65.
2. Decisions regarding worker protective measures, routine work procedures, and emergency actions shall be based on data collected during air monitoring.
3. Sampling shall be conducted on a regular basis, and additionally as required by special or work-related conditions, by the Contractor's health and safety personnel. All monitoring data shall be recorded in a site safety log and shall become part of the overall site record. Reports of the air monitoring results shall be transmitted to the Engineer.

4. The Contractor shall ensure that the degree and type of respiratory protection provided for on-site employees is consistent with the monitored concentrations of airborne contaminants.

B. Personnel Monitoring by Contractor

1. The climate, combined with the requirements for personal protective equipment, may create heat or cold stress. The Contractor shall incorporate requirements for monitoring personnel physiological parameters to prevent deleterious effects on personnel. The CSSP shall include provisions for either modifying work schedules or implementing the use of protective wear to avoid injury due to heat or cold stress. Refer to "Occupational and Health Guidance Manual for Hazardous Waste Site Activities," published October 1985 by the National Institute of Occupational Safety and Health (NIOSH)/OSHA/United States Coast Guard (USCG)/United States Environmental Protection Agency (EPA).

## 1.13 EMERGENCY PROVISIONS (SECTION J OF THE CSSP)

A. Develop a response plan for on-site and off-site emergencies that shall address, at a minimum, the following, and comply with 29 CFR 1926.65:

1. Pre-emergency planning.
2. Personnel roles, lines of authority, training, and communication.
3. Emergency recognition and prevention.
4. Safe distances and places of refuge.
5. Site security and control.
6. Evacuation routes and procedures.
7. Decontamination.
8. Emergency medical treatment and first aid.
9. Emergency alerting and response procedures.
10. Critique of response and follow-up.
11. Personal protective equipment and emergency equipment.
12. Notification of emergency services.

B. All accidents and unusual events shall be dealt with in a manner that minimizes continued health risk of site workers and the general public. Include an Emergency Preparedness Plan in the CSSP, which shall include, at a minimum, those items listed below. The plan shall be prepared in accordance with 29 CFR 1926.65.

1. First aid or other appropriate initial action shall be administered by those closest to the accident/event. This assistance shall be conducted in a manner that ensures that those rendering assistance are not placed in a situation of unacceptable risk.
2. All accidents or unusual events shall be reported to the appropriate Contractor employee. This individual is responsible for conducting the emergency response in an efficient, rapid, and safe manner. He or she will decide if off-site assistance and medical treatment are required and arrange for any necessary assistance. In any event, the Engineer shall be notified.

3. In the event of an emergency requiring notification of off-site personnel, the Contractor's Construction Superintendent shall be responsible for immediately notifying appropriate agencies and personnel. If, for some reason, he or she is not available, another Contractor employee shall perform this function. The Engineer shall be continually apprised of the situation.
4. Immediately inform the Engineer of any accident or unusual event involving the general public.

C. A roster of names and phone numbers of all personnel and agencies that could be involved in an emergency response shall be developed by the Contractor and will be posted at several prominent locations at the site. The following contacts shall be included on this list:
1. Fire department.
2. Police.
3. Ambulance.
4. Hospital.
5. Poison center.

D. These contacts shall be informed of the operations at the start of the job. In addition, a map showing the location of the hospital will be included and the route checked. Map shall include written directions.

E. When work is being accomplished, the following portable equipment and facilities shall be readily available to work locations, or immediately adjacent to active work locations:
1. A portable emergency eyewash.
2. One Class ABC-type, portable fire extinguisher with a 2A:10BC rating.
3. Each vehicle and item of motorized equipment used in the work zones shall be equipped with a one Class ABC-type, portable fire extinguisher with a 2A:10BC rating.
4. Two-way radios.
5. First-aid kit complying with 29 CFR 1926.50(d)(i).
6. Stretcher.

F. Maintain a completed OSHA Form 200 on site.

## 1.14 SITE SECURITY AND CONTROL (SECTION G OF THE CSSP)

A. The Contractor is wholly and totally responsible for the security of Contractor-owned, -rented, or -supplied material and equipment, no matter where it is located. This section of the CSSP shall describe the following:
1. Control measures around work areas and excavation activities.
2. Security measures to be employed to protect the Contractor's equipment.

## 1.15 STANDARD OPERATING PROCEDURES, RECORDKEEPING, AND REPORTING (SECTION I OF THE CSSP)

A. Maintain logs and reports covering implementation of the CSSP and present the format of these logs and reports in the CSSP. The formats shall be developed by the

Contractor to include training logs, weekly reports, and phase-out reports. Maintain applicable Standard Operating Procedures (SOPs) on site.

B. Training logs shall include records of both initial and refresher training and shall also include:
   1. Personnel trainee name (with attendance check and signature).
   2. Topic covered and time spent in training session.
   3. Equipment demonstrations and practice.
   4. Other training, including fit-testing of respirators.
   5. Date and place of training.

C. Weekly reports shall include:
   1. Summary sheet covering range of work done.
   2. Any incidents of:
      a. Non-use of protective devices in an area where required.
      b. Non-use of protective clothing.
      c. Disregard of buddy system.
      d. Eating and smoking in prohibited areas.
      e. Instances of job-related injuries and illness (an accident report will also be required).

D. Develop SOPs pertinent to the activities on site. The Contractor's existing SOPs may be utilized to the extent that they are applicable and to the extent that they are in accordance with these Specifications. SOPs shall address personal precautions and operations. All personnel affected shall be familiar with the SOPs, a copy of which shall remain on site at all times.

## 1.16 HEALTH AND SAFETY RISK ANALYSIS (SECTION B OF THE CSSP)

A. Physical Hazards
   1. Safe operation of heavy earth-moving equipment and supply vehicles requires that:
      a. Only trained and qualified individuals be permitted to operate this type of equipment.
      b. Maintenance programs be thorough and comply with the manufacturer's specifications.
   2. Hazards that may be encountered or caused by earth-moving equipment include, but are not limited to, the following:
      a. Normal traffic hazards.
      b. Potential for equipment roll-over.
      c. Potential for moving equipment to damage structures.
      d. Potential for equipment fires.
      e. Potential for trench collapse.
      f. Potential for moving equipment to injure employees and the general public.
      g. Potential for sudden ground subsidence in areas that have had subsurface fires.
   3. Excavation work shall conform to OSHA requirements as covered in 29 CFR 1926.650. Before excavation work begins, underground utilities such as

electric, gas, water, and sewer mains shall be located and marked. Once the excavation work has started and a trench has been dug, the following precautions shall be taken to reduce the likelihood of injuries:

a. Every trench in which employees may be exposed to cave-in and which is over five (5) feet in depth, regardless of soil type (except solid rock), must be shored, braced, and/or otherwise stabilized in accordance with OSHA regulations.
b. Prior to an employee entering a trench or depression, the atmosphere must be checked using an O2/explosimeter to assure that there is sufficient oxygen and no explosive atmosphere. These areas will also be surveyed using a real-time organic vapor analyzer (OVA), and hydrogen sulfide and sulfur dioxide monitoring equipment prior to entry and routinely during the work.
c. The Contractor shall evaluate the work area and determine if a confined space permit is required for below-ground work, in accordance with 29 CFR 1910.146.
d. Ladders shall be provided at twenty-five- (25)-foot intervals along the trench.
e. Employees shall not work in a trench alone.
f. Excavations that must be left open during non-work periods must be isolated using barricades (e.g., temporary orange construction fence).
g. Trenches shall be kept free of any standing water.

4. Address any physical hazard that may expose a worker or local residents to injury. List the hazards anticipated and the specific methods for handling each potential hazard.
5. Define specific methods to be used to prevent local residents from accessing the work zone during hours of work.

## 1.17 ACTION LEVELS (SECTION B OF THE CSSP)

A. Action levels for employee protection and emergency actions shall be defined and included in the CSSP. Action levels should be based on airborne concentrations of contaminants observed during the air quality monitoring of the work site.
B. Action levels for organic vapors shall be established by the Contractor based upon levels above background determined using an OVA or equivalent instrument.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for worker qualifications to ensure quality of Work.

### 1.2 REFERENCE STANDARDS

[Not used.]

### 1.3 QUALIFICATIONS OF WORKERS

A. For each portion of the Work, provide at least one (1) person per shift who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the referenced standards and requirements of the Work, and who shall personally direct all work performed under each section.

B. For each portion of the Work, provide a sufficient number of skilled workers who are thoroughly familiar with the type of construction, materials, and techniques specified.

C. No allowance will be made in the acceptance or rejection of any portion of the Work for lack of skill on the part of the workers.

D. Where regulatory requirements mandate that one or more workers performing a task have specialized training or certification, provide workers that possess such training or certification.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

### 1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Design Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Design Document requirements.
3. Requirements for Contractor to provide quality-control services required by Engineer and Quality Assurance Officer (QAO), or authorities having jurisdiction are not limited by provisions of this Section.

### 1.2 REFERENCES

A. American Society for Testing and Materials

1. ASTM E 548: General Criteria Used for Evaluating Laboratory Competence.

### 1.3 SUBMITTALS

A. Contractor Quality Control Plan (CQC): Prepare a CQC Plan and submit to the Engineer for review and approval. Construction will be permitted to begin only after acceptance of the CQC Plan <u>or acceptance of an interim plan applicable to the particular feature of work to be started</u>. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. The CQC Plan shall include, as a minimum, the following to cover all construction operations, both on site and off site, including work by subcontractor, fabricators, suppliers, and purchasing agents:

1. *Personnel:* The Contractor shall identify a Quality Control Inspector (QCI), member of either Contractor's staff or prime subcontractor's staff, who shall perform QC procedures and implement the CQCP. The QCI may have other duties on site but shall be neither the Contractor's nor prime subcontractor's project manager or site superintendent. The QCI shall have the authority to communicate directly with the Contractor's home office management and shall have the authority to stop the work if critical components are not functioning as intended. The QCI shall be onsite at all times when work is actively being performed. The resume

of the QCI shall be included with the CQCP and shall show either formal training in QA/QC procedures or at least 6 months of cumulative experience acting in a similar role on other project(s) of a similar scope.

2. *Documentation.* The QCI shall maintain a Quality Control Field Notebook documenting all inspections and observations made by the QCI. This notebook shall be available upon demand at all times to either the Engineer or the Agency.
3. *Checklist.* As part of the CQCP, the Contractor shall develop a checklist indicating items that must be observed and the frequency of observation. Additionally, all required tests shall be identified. The Contractor may propose some of these tests as part of submittals required under other sections of these Specifications. In developing the checklist, the Contractor shall list every Specification section and all specific items in each section that must be inspected.
4. Names, qualifications of all sub-contractors including laboratory testing facilities.
5. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off-site fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330, CONTRACTOR SUBMITTALS.
6. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Laboratory facilities will be approved by the Engineer.
7. Reporting procedures, including proposed reporting formats. As a minimum, the written report shall be certified and include:
   a. Date of issue;
   b. Testing agency name, address, and telephone numbers;
   c. Dates and locations of samples and tests or inspections;
   d. Description of the work;
   e. Test inspections and interpretation of test results;
   f. Name and signature of laboratory inspector;
   g. Recommendations on re-testing and re-inspecting.
8. A list of the definable features of work. A definable feature of work is a task that is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

B. Qualification Data: For testing agencies specified in QUALITY ASSURANCE to demonstrate their capabilities and experience. Include proof of qualifications to Engineer in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Permits, Licenses, and Certificates: For Owner and QAO's records, submit four copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.4 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed by Contractor before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

## 1.5 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Design Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Engineer.

## 1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

## 1.7 QUALITY CONTROL

A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Do not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
   2. Notify testing agencies at least forty-eight (48) hours in advance of time when Work that requires testing or inspecting will be performed.
   3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including re-testing and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Design Documents. Engineer reserves the right to request the use of a different laboratory for re-testing and re-inspecting.

D. Testing Agency Responsibilities: Cooperate with Engineer, QAO, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Engineer, QAO, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

3. Submit a certified written report of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Design Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

## 3.1 ACCEPTANCE OF CONTRACTOR'S CQC PLAN

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

## 3.2 REPAIR AND PROTECTION

A. Acceptance of Plan: Acceptance of the Contractor's CQC Plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Engineer reserves the right to require the Contractor to make changes in the CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

B. Notification of Changes: After acceptance of the CQC Plan, notify the Engineer in writing a minimum of seven (7) days prior to any proposed change. Proposed changes are subject to acceptance by the Engineer.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for provision, maintenance, and removal of the Engineer's and/or Agency's field office structure and contents.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01520 – Temporary Utilities.
C. Section 02910 – Demobilization.

### 1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI) A10.6 (1990), Safety Requirements for Construction and Demolition.
B. Temporary Electrical Facilities [Monograph in Electrical Design Library] (1985).
C. National Fire Protection Association (NFPA) 10 (1998), Portable Fire Extinguishers.
D. NFPA 70 (2002), National Electrical Code.
E. NFPA 241 (1996), Safeguarding Construction, Alternation, and Demolition Operations.

### 1.4 REQUIREMENTS FOR FACILITIES

A. Structurally sound, weathertight, with floors raised above ground.
B. Insulation: Compatible with occupancy and storage requirements.
C. Field office shall be equipped with adequate locks to prevent vandalism. Contractor shall provide two keys to the Engineer, and two keys to the Agency.
D. Provide potable water for drinking and washing.
E. Furnish and install a portable toilet(s) for use by site personnel.

### 1.5 SUBMITTALS

A. Mobilization/Demobilization Plan: Prepare a Mobilization/Demobilization Plan that includes methods and materials required for mobilization to the project and demobilization from the project. Mobilization shall include provisions for connection of all necessary utilities, placement of all site facilities and controls, and construction of decontamination facilities. Demobilization shall include decontamination of all Contractor equipment, collection and disposal of all Contractor-generated material, disconnection of utilities, removal of Contractor facilities, and repair and restoration of any site fences, roads, or permanent facilities.

## 2.0 PRODUCTS

### 2.1 MATERIALS, EQUIPMENT, AND FURNISHINGS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Agency's Representative. Provide materials suitable for use intended.

B. Water: Potable.

### 2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air-conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand-carried, portable, Underwriters Laboratory (UL)-rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
   1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. One Self-Contained Toilet Unit: Single-occupant unit of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-drinking-water units, including paper cup supply.
   1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 degrees Fahrenheit (°F).
   2. Contractor-provided bottled water refills.

F. Electrical Outlets: Properly configured, National Electric Manufacturers Association (NEMA)-polarized outlets to prevent insertion of 110- to 120-volt (V) plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

G. Power Distribution System Circuits: Where permitted and installed overhead and exposed for surveillance, wiring circuits, not exceeding 125-V alternating current (ac), 20-ampere (A) rating, and lighting circuits may be nonmetallic sheathed cable.

## 3.0 EXECUTION

### 3.1 INSTALLATION

A. Have office equipped and ready for use at the time fieldwork begins at the site.

B. Construct temporary field office on proper temporary foundation; and provide connections for utility services.
   1. Secure portable or mobile buildings when used.
   2. Provide steps and landings at entrance doors.

C. Install at a location approved by the Engineer.

## 3.2 REMOVAL

A. Remove temporary field office, contents, and services after completion of all construction work.

B. Remove foundations and debris; and restore the area to its original or better condition.

C. Refer to Section 02910, DEMOBILIZATION.

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

### 1.1 SCOPE

A. This section covers requirements for utilities at areas where temporary utility services are required by the Engineer, Agency, and/or Contractor.
B. Provide temporary electrical power to the field offices.
C. Provide temporary Internet hook-up for Engineer/Agency use.
D. Utilities shall be in the Contractor's name.

### 1.2 RELATED WORK

A. Section 01510 – Temporary Construction Trailer.

### 1.3 REFERENCE STANDARDS

A. Occupational Safety and Health Administration (OSHA) 29 CFR 1910.
B. NFPA 70 (2002), National Electrical Code.

### 1.4 SUBMITTALS

A. Provide details of any proposed modifications to the existing utility system as part of the Mobilization/Demobilization Plan as specified in Section 01510, TEMPORARY CONSTRUCTION TRAILER.

### 1.5 COSTS

A. The Contractor shall bear all reimbursable expenses for placing, relocating, and removing all utilities until this Contract is complete.
B. The Contractor is responsible for utility payments.
C. Contractor shall be responsible for payment of all utility installation and utilization charges associated with the field office.

## 2.0 PRODUCTS

A. As required and approved by the utility company affected.

## 3.0 EXECUTION

A. All work shall be in accordance with utility company requirements.
B. All temporary electrical connections shall be accordance with OSHA and the National Electric Code (NEC).
C. Arrange for the utility company to connect and disconnect services to the equipment and office on the site.

*** END OF SECTION ***

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# SECTION 01550
# EQUIPMENT AND MATERIAL DECONTAMINATION

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## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers the decontamination of all construction equipment and materials that encounter groundwater and/or groundwater contaminated soils during the Work.

B. Equipment decontamination shall be in compliance with Section 01350, CONTRACTOR SITE SAFETY PLAN and Section 01560, ENVIRONMENTAL PROTECTION.

### 1.2 RELATED WORK

A. Section 01340 - Construction Operations Plan.
B. Section 01350 - Contractor Site Safety Plan.
C. Section 01560 - Environmental Protection.
D. Section 02420 - Off-Site Disposal.

### 1.3 REFERENCES

[Not used.]

### 1.4 DEFINITIONS

A. Exclusion Zone: Refer to Section 01350, CONTRACTOR SITE SAFETY PLAN.

B. Contamination-Reduction Zone: Refer to Section 01350, CONTRACTOR SITE SAFETY PLAN.

### 1.5 SUBMITTALS

A. Submit provisions for equipment decontamination, as described below, as an element of the COP (Section 01340, CONSTRUCTION OPERATIONS PLAN).

## 2.0 PRODUCTS

### 2.1 EQUIPMENT

A. If needed or required, the Contractor shall use a pressure washer capable of producing a minimum temperature of one hundred eighty (180) °F and a minimum pressure of two thousand five hundred (2,500) pounds per square inch (psi) to decontaminate equipment. Less capable equipment may be used if it can be demonstrated to be effective.

B. The Contractor shall provide all other pumps, tanks, sumps, cleaning tools, and equipment, and other supplies and materials required to effectively decontaminate equipment.

## 3.0 EXECUTION

### 3.1 EQUIPMENT DECONTAMINATION

A. Before being removed from the site, all debris, equipment, and vehicles in contact with groundwater, as well as personal property in contact with saturated soils or groundwater, shall be cleaned first by brushing off gross contamination, and then with a pressurized steam cleaner, water jet, and/or hose sprayer until all visible traces of soil are removed.

B. Personnel staffing the decontamination work shall comply with all applicable provisions of the Contractor's Site Safety Plan.

C. Hand tools and other hand-carried items that have come into contact with groundwater shall be washed with detergent and water, and then rinsed with tap water.

### 3.2 PERSONNEL DECONTAMINATION

A. All personal protective equipment (PPE) that has come in contact with contaminated site soils and/or groundwater shall be removed and deposited in proper refuse containers.

### 3.3 WASTE COLLECTION AND DISPOSAL

A. All decontamination wastewater shall be handled as specified in Section 01560, ENVIRONMENTAL PROTECTION.

B. Soil collected during decontamination and all other waste soils shall be deposited on site at appropriate stockpile areas as directed by the Engineer.

C. All PPE to be disposed of that has come in contact with contaminated site soils and/or groundwater shall be brushed clean of all loose soil, rendered unusable, bagged, and placed in a container(s) for temporary storage on site. Before Project closeout, dispose of materials at an appropriate off-site disposal facility per Section 02420, OFF-SITE DISPOSAL.

D. All other materials to be disposed of that have come in contact with contaminated site soils and/or groundwater shall be double-bagged and placed in a container(s) for temporary storage on site in an area designated by the Engineer. Precautionary labels shall be affixed prominently to containers of contaminated scrap, waste, debris, and clothing, as necessary. Containers shall be sealed and moved only with proper equipment, and shall be secured to prevent dropping or loss of control during transport. Before Project closeout, dispose of materials at an appropriate off-site disposal facility per Section 02420, OFF-SITE DISPOSAL.

E. The Contractor shall obtain all necessary permits and approvals from the disposal facility(ies) and/or governing agencies prior to hauling any waste off site. Transport and dispose of materials in accordance with applicable federal, Agency, and local regulations.

* END OF SECTION *

## 1.0 GENERAL

### 1.1 DESCRIPTION

A. This section covers the means and methods the Contractor shall employ in protecting the environment in and around the project site.
B. The Contractor shall strictly adhere to the measures specified herein, and take additional measures, as may be required by federal, state, and local regulations, to minimize any adverse impacts to the environment during the performance of work.
C. The Contractor's activities shall be limited to the boundaries of the work areas, and public rights-of-way.
D. The requirements herein are in addition to requirements in other sections of the Specifications.

### 1.2 RELATED WORK

A. Section 01562 – Wastewater Management.

### 1.3 REFERENCE STANDARDS

A. Processes, Procedure, and Methods to Control Pollution Resulting from All Construction Activity, EPA 43019-73-007.
B. 35 Illinois Administrative Code (IAC) 212.301, 212.315, and 212.316(c).
C. 35 IAC 703.121, meet requirements only.
D. All other applicable Federal, State, and local regulations, laws, and ordinances.

### 1.4 SUBMITTALS

[Not used.]

### 1.5 PROTECTION OF WATER QUALITY

A. It is imperative that watercourses do not become contaminated, as applicable, with sediment, leachate, or other contaminants.
B. The Contractor shall be fully responsible for any and all damages to life, property, and animal life that occur as a result of his activities. Damages resulting from polluting watercourses shall be repaired, restored, or compensated for by the Contractor.
C. Observe rules and regulations of the State of Illinois and agencies of the U.S. Government prohibiting pollution of any stream, river, or wetland by dumping of refuse, wastewater, rubbish, or debris therein.
D. Comply with procedures outlined in the EPA manual, entitled Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity, EPA 43019-73-007.
E. Refer to Section 01562, WASTEWATER MANAGEMENT, for wastewater

disposition specifications.

## 1.6 PROTECTION OF AIR QUALITY

A. Air Quality Objectives are:
   1. Compliance with State and Federal Ambient Air Quality Standards for all parameters throughout the community surrounding the work areas as applicable.
   2. All practical methods for the suppression of fugitive dust are to be used as normal practice, if applicable.

B. Minimize potential for air pollution by wetting down bare and disturbed soils; properly operate combustion emission control devices on all construction vehicles and equipment; and shut down motorized equipment when not in use.

C. Refuse burning will not be permitted.

D. If temporary heating devices are necessary for protection of work, such devices shall be of type that will not cause air pollution.

## 1.7 USE OF CHEMICALS

A. Chemicals used, whether herbicide, pesticide, disinfectant, polymer, reactant, or other classification, must be approved by either the Illinois Environmental Protection Agency (Illinois EPA), EPA, or United States Department of Agriculture (USDA), or any other applicable regulatory agency and be used in a manner consistent with their original purpose.

B. Use of such chemicals and disposal of residues shall be in conformance with manufacturer's instructions.

C. Use of chemicals must be approved in advance by the Engineer.

## 1.8 NOISE AND DUST CONTROL

A. Conduct operations to minimize the potential for annoyance to residents in the vicinity of the work, and comply with applicable local ordinances.

B. Equip compressors and other apparatus with such mechanical devices as may be necessary to minimize noise and dust. Equip compressors with silencers on intake lines.

C. Equip gasoline- or oil-operated equipment with silencers or mufflers on intake and exhaust lines.

D. Provide dust suppression using water spray on unpaved roads in construction area as needed to minimize dust. Applicable environmental regulations for dust prevention will be strictly enforced.

E. Comply with Federal, State, and noise regulations as applicable.

## 1.9 EROSION CONTROL MEASURES

A. Temporary Measures

1. The Contractor shall provide temporary control measures as hereinafter specified to control, minimize, and prevent soil erosion and water pollution that could be brought about by the effects of his construction operations and/or procedures upon the existing terrain. The requirements of this section shall apply to all water flowing over the work areas.
2. The temporary pollution control provisions contained herein shall be coordinated with the permanent work to be performed under this Contract to the extent practical, to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.
3. Temporary pollution control measures shall be provided for work performed outside the limits of the work areas, when such work is necessary (e.g., haul roads).

B. Construction Requirements
1. It shall be the responsibility of the Contractor to investigate and comply with all applicable federal, state, and local laws and regulations concerning pollution of waterways. In the event of conflict between the requirements of these Specifications and pollution control laws, rules, or regulations of federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.
2. Temporary pollution control measures shall be used to correct conditions that develop during construction, and shall also be implemented if they are needed prior to completion of the permanent Work or are needed temporarily to control erosion that develops during normal construction activities.
3. No waste containing dissolved or suspended toxic or other objectionable material shall be discharged into a waterway.
4. The Agency and Engineer shall be immediately notified of any known occurrence of pollution. The Contractor shall be fully responsible for any damages resulting from contaminated water entering watercourses as a result of the Contractor's negligence, carelessness, or failure to install required temporary or permanent pollution control measures.
5. In the event of any spill or release of pollutant(s), appropriate notification of authorities is the responsibility of the Contractor. Notification of the Agency and Engineer will not replace or relieve the Contractor of the responsibility to notify other appropriate governmental authorities.

## 1.10 CONSTRUCTION EQUIPMENT

A. The Contractor's equipment that is left on site shall be maintained in such a manner as to prevent leaks and spills of oil, gasoline, lubricants, and other materials used for maintenance work.

B. The Contractor shall be responsible for cleanup and proper disposal of any materials spilled onto a work area or surrounding areas, as well as materials contaminated as a result of the spill. Cleanup and disposal shall be at the Contractor's expense.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

[Not used.]

*** END OF SECTION ***

## 1.0 GENERAL

## 1.1 DESCRIPTION

A. This section covers the means and methods the Contractor shall employ in management of wastewater generated in and around the project site.

B. Wastewater includes:
   1. Equipment, material, and debris decontamination wastewater.
   2. Personnel decontamination water.
   3. Rainwater from open excavations and stockpiles. For additional requirements concerning rainwater, refer to Section 01560, ENVIRONMENTAL PROTECTION.
   4. Groundwater removed from wells during development activities.

## 1.2 RELATED WORK

A. Section 01560 – Environmental Protection.

## 1.3 SUBMITTALS

[Not used.]

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

A. Equipment, material, and debris decontamination wastewater shall be collected in on-site depressions and allowed to percolate.

B. Personnel decontamination water shall be collected in on-site depressions and allowed to percolate.

C. Uncontaminated runoff from rainwater shall be directed to stormwater collection areas (swales or sewers) or be allowed to percolate.

D. Groundwater removed from wells during development activities shall be containerized and discharged through the ISCA treatment system.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SCOPE

A. This section covers minimum requirements for traffic regulation and control during the course of Work.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.

### 1.3 REFERENCE STANDARDS

A. Standard Specifications for Road and Bridge Construction (IDOTSPEC), Illinois Department of Transportation, 2007.

B. Manual on Uniform Traffic Control Devices (MUTCD), United States Department of Transportation, Federal Highway Administration, Millennium Edition (as amended).

C. Traffic Control and Protection Standard Drawings, Illinois Department of Transportation.

### 1.4 ANTICIPATED INTERFERENCE WITH TRAFFIC

A. Reload, Inc. traffic along the site entrance and within the vicinity of the ISCA P&T system support area. Tractor trailer and forklift operation during Reload daily operations will pose significant hazards to personnel and equipment during commencement of the Work.

B. Work-related traffic entering and leaving the support area near the ISCA P&T system. This includes trucks making deliveries and equipment being loaded and unloaded as part of the Work. Based on equipment specified for completion of the Work, oversize loads are anticipated.

C. Connection of P&T extraction wells to the P&T building. This may include trenching across roadways for underground piping connections.

### 1.5 INTENT

A. It is the intent to require the Contractor to maintain excellent safety conditions for his workers, the public (drivers and pedestrians), and all vehicles.

B. Within the requirements above, it is the intent to minimize the inconvenience to the public and to Reload Inc. operations.

C. Emergency vehicles shall be given the right-of-way in all situations.

## 1.6 CONFLICTS

A. Should the requirements herein be in conflict with current or future federal, state, or local laws and regulations, the conflict shall be brought to the attention of the Engineer. The more stringent requirement shall govern.

## 1.7 SUBMITTALS

A. Submit a detailed Traffic Control Plan.
B. The following shall be included in the Traffic Control Plan:
   1. Name of the individual employee of the Contractor who has overall traffic control responsibilities per Paragraph 3.1.H.
   2. For each separate case where traffic flow will be interrupted or altered, provide a sketch indicating all traffic control devices.
C. The Traffic Control Plan shall be submitted to the Engineer, who will arrange for review.

## 2.0 PRODUCTS

A. The products specified herein shall be leased or owned by the Contractor and will not become property of the Agency. All products specified herein shall be removed from the Work site when no longer needed.
B. Items such as safety vests, flags or signs for flagmen, and communication devices shall be standard and adequate for their intended function. They shall be in accordance with IDOTSPEC where applicable, and as approved by the Engineer.

## 3.0 EXECUTION

## 3.1 GENERAL

A. When any section of road is closed for construction activities of any type, or when traffic is to be maintained along the route adjacent to construction activities, the Contractor shall protect the workers and provide for safe and convenient public travel by furnishing, erecting, and maintaining to the satisfaction of the Engineer and in accordance with traffic control standards, all signs, signals, markings, traffic cones, barricades, warning lights, flaggers, and other traffic control devices/personnel required for the type of operation being performed. Number, type, color, size, and placement of all traffic control devices shall conform to the Traffic Control Plan and the MUTCD.
B. Hazardous conditions, created by the Contractor's operation and not controlled by traffic control standards or designs, shall be protected against by adequate safety devices at the Contractor's expense.
C. Barricades and/or cones used for channelization or delineation and warning signs shall be sequentially placed in the direction of the traffic flow and removed in reverse order.

D. Any traffic control barrier that has become ineffective due to damage or defacement shall be replaced by the Contractor. All traffic control devices shall be kept clean and neat. The Engineer shall be the sole judge as to the acceptability of placement and maintenance of all traffic control devices.

E. Temporary traffic control devices shall remain in place only as long as they are needed and shall be removed as soon thereafter as practical.

F. At all times when workers are present, or where two-lane traffic is to be maintained over one lane of pavement, flaggers shall be furnished to protect the workers and to warn and direct traffic. Two (2) flaggers will be required for each operation where two-way traffic is maintained over one lane of pavement, in accordance with Traffic Control and Protection Standard 701336.

G. All vehicles and/or non-operating equipment parked for a short period of time (as defined in IDOTSPEC as two [2] hours or less) shall be eight (8) feet from the moving traffic lane. Longer periods shall be in accordance with Paragraph 3.3.A.

H. The Contractor shall furnish the name of the individual in his direct employ who is to be responsible for the installation and maintenance of traffic control for the project. If the actual installation and maintenance are to be accomplished by a subcontractor, consent shall be requested of the Engineer during the pre-construction conference. This shall not relieve the Contractor of the foregoing requirement for a responsible individual in his direct employ.

## 3.2 SURVEY PARTY

A. Redirect pedestrian and sidewalk traffic.

B. If work is restricted to sidewalks, easements, and areas farther away from the road, no additional traffic signs are required.

C. At other areas, refer to Paragraph 3.3.A.

## 3.3 TRAFFIC CONTROL

A. Work not immediately adjacent to roadway:
   1. Work located from two (2) to fifteen (15) feet from the edge of the pavement will be protected in accordance with Traffic Control and Protection Standard 701316.
   2. All hazards or unattended obstacles within fifteen (15) feet from the edge of the pavement are required to be protected with Type I or II barricades with lights.
   3. During working hours, all vehicles and/or non-operating equipment parked for a short period of time (two [2] hours or less) shall be eight (8) feet from the moving traffic lane.
   4. During non-working hours, all materials and equipment shall be stored a minimum of thirty (30) feet from the pavement, or behind man-made or natural barriers when such barriers are adjacent to the traffic lane of the Work area. Stored materials or equipment within fifteen (15) feet of the pavement is prohibited.

B. Pedestrian Traffic. Any area of excavation adjacent to the public or residences must be protected by fencing or other approved methods to protect pedestrian traffic.

## 3.4 TRUCK TURNS AND CROSSINGS

A. Whenever trucks or other equipment turns off a public street, the Contractor shall ensure that the trucks or equipment does not stop and block or otherwise protrude into the shoulder or lane of traffic.

B. Under infrequent special circumstances, provide flaggers if turning of trucks or other equipment will create a potential traffic hazard.

## 3.5 RAILROAD RIGHT-OF-WAY

A. Whenever work is performed within the right-of-way of a railroad, the requirements of IDOTSPEC Section 107.04, and 107.10 through 107.12 shall be followed.

## 3.6 REGISTRATION

A. Except as provided by IDOT regulations, all vehicles and equipment operating on public streets shall be licensed by the State of Illinois.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for identification and work in the vicinity of utilities and other subsurface features.

B. *There is power supplied to the site. It is the Contractor's responsibility to make any* necessary connections for use.

### 1.2 RELATED SECTIONS

A. Section 01340 – Construction Operations Plan

B. Section 02215 – Well Abandonment

### 1.3 IDENTIFICATION

A. Approximate locations of buried utilities and subsurface features associated with the ISCA P&T System are presented on the Drawings.

B. The Contractor shall assume other overhead utilities, buried utilities, and subsurface features could exist. Locations of subsurface features and utilities inside the property line are not known.

C. The location of subsurface features and utilities outside the property line are not known.

D. THE CONTRACTOR SHALL BE RESPONSIBLE FOR AVOIDANCE AND PROTECTION OF ALL UTILITIES AND OTHER SUBSURFACE FEATURES. Call the Chicago Utility Alert Network (DIGGER) at 1-312-744-7000 at least two (2) business days before performing any subsurface work.

E. Numerous monitoring wells exist at the site as indicated on the Drawings. The Contractor shall field-locate and protect all wells during the site activities, unless otherwise noted. Where wells are located within the area of work and damage cannot otherwise be avoided (as determined by the Engineer), said wells shall be properly abandoned in accordance with Section 02215, WELL ABANDONMENT.

F. The location of subsurface wastes, including drummed material, within the site boundaries is not known. Therefore, it should be assumed that such materials may be encountered whenever excavation occurs. These wastes may have the potential to be highly hazardous, flammable, explosive, toxic, etc.

### 1.4 SUBMITTALS

A. The Contractor shall submit as part of the COP (Section 01340, CONSTRUCTION OPERATIONS PLAN) explicit methods and procedures that shall be used for identification and protection of all on-site utilities and subsurface features.

## 2.0 PRODUCTS

[Not Used.]

## 3.0 EXECUTION

A. It shall be the responsibility of the Contractor to accurately field-locate and prevent damage to all utilities and subsurface features. If any utility or subsurface features are damaged, they shall be repaired or replaced at the Contractor's expense.

B. It shall be the responsibility of the Contractor to meet all utility crossing requirements and conditions, as may be required by federal, state, and local regulations as well as the public or private entity providing the utility.

C. The Contractor shall notify all utility providers well in advance of performing work near utilities or within a utility easement as it is anticipated that representatives from utility providers may request to be present during the work.

D. The Contractor shall not excavate using heavy equipment (backhoes, bulldozers, jackhammers, etc.) within two (2) feet in either direction of known utility lines. Excavation at these locations shall be completed using hand tools.

E. If abandoned subsurface lines are encountered, they shall be brought to the immediate attention of the Engineer. In general, these lines may be cut at the limit of excavation. However, if there is evidence that product remains within these lines, the Engineer shall direct how to treat these lines.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for construction aids.
B. All construction aids must be in accordance with current OSHA standards.

### 1.2 RELATED WORK

A. Section 01340 – Construction Operations Plan.
B. Section 02300 – Earthwork.

### 1.3 REFERENCE STANDARDS

A. OSHA 29 CFR 1910.

### 1.4 SUBMITTALS

A. All foreseen construction aids and descriptions of their use at the site shall be included in the Construction Operations Plan (Section 01340, CONSTRUCTION OPERATIONS PLAN).

### 1.5 DEFINITION

A. Construction aids are temporary devices or supports necessary or convenient for completion of the work described herein.

### 1.6 DESIGN AND USE

A. The Contractor is responsible for the design, construction, use, and removal of all construction aids, as necessary.
B. For construction aids not specifically noted herein, use the best standard practice for the design and construction.
C. Should the Engineer detect any perceived unsafe condition during the course of this Contract, the Engineer will report same to the Contractor's shift superintendent, who shall immediately investigate the situation and remedy it if the superintendent deems it necessary.

### 1.7 FIELD LAVATORY

A. The Contractor shall be responsible for procurement, installation, maintenance, and removal of a portable field lavatory for the duration of the fieldwork.

## 1.8 LADDERS, SCAFFOLDING, AND STAGING (IF ELECTED)

A. Provide ladders, scaffolding, and/or staging as necessary to accomplish the work. Scaffolding may be of suspension type, or of standing type such as metal tube or coupler, tubular welded frame, pole or outrigger, or cantilever. The type, erection, and use of all scaffolding shall comply with all applicable OSHA provisions, including railings and toeboard use.
B. Erect and move scaffolding in a manner precluding damage to anything.
C. See Paragraph 1.9.D below.

## 1.9 SHORING AND BRACING (IF ELECTED)

A. Provide shoring, bracing, and/or other measures according to OSHA requirements whenever:
   1. The depth of excavation exceeds five (5) feet;
   2. Soil and groundwater conditions create unstable conditions; or
   3. Potential traffic or construction equipment loadings could create unstable conditions.
   4. See Subparagraph 1.9.D. below
B. Refer to Section 01350, CONTRACTOR SITE SAFETY PLAN, for other requirements concerning trenches.
C. Refer to Section 02300, EARTHWORK.

## 1.10 FENCING

A. Temporary fencing shall consist of orange polyvinyl chloride (PVC) fabric attached to steel posts, or approved equal.

## 2.0 PRODUCTS

A. The products specified herein shall be leased or owned by the Contractor and will not become property of the Agency. All products specified herein shall be removed from the Work site when no longer needed.

## 3.0 EXECUTION

1. A temporary construction fence shall be used by the Contractor to barricade all open excavations or to restrict access to staging areas or areas where construction activities are under way.
2. Post spacing, setting, and fabric attachment shall be appropriate to provide a sturdy and durable temporary construction fence.
3. Fence material shall have a high-visibility coating. Minimum height of fence shall be four (4) feet.
4. The fence shall be maintained as necessary until completion of activities requiring the fencing.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers the storage requirements for materials, equipment, and supplies that are to be used during the course of this project.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.
C. Store products subject to damage by the elements in substantial weathertight enclosures.
D. Provide substantial platforms, blocking, or skids to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.
E. For products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SUMMARY

A. Items included in this section cover the responsibilities of the Contractor for site maintenance during this project.

### 1.2 RELATED WORK

A. Section 01560 – Environmental Protection.
B. Section 02420 – Off-Site Disposal.

## 2.0 PRODUCTS

### 2.1 STORAGE OF MATERIALS

A. All materials as specified herein shall be stored and transported in appropriate containers.

## 3.0 EXECUTION

### 3.1 BEFORE CONSTRUCTION

A. The Contractor shall clean the support and staging areas of debris, rubbish, and refuse materials that have been dumped, washed, or blown onto the site.

### 3.2 DURING CONSTRUCTION

A. The Contractor shall periodically clean the site and adjacent properties, as necessary, to keep them clean from debris, rubbish, and refuse materials resulting from work activities.
B. The Contractor shall clean the site on a daily basis to collect any and all waste materials, rubbish, and discarded equipment.
C. The Contractor shall provide container(s) for the collection of all waste materials, debris, rubbish, and refuse.
D. All waste materials, debris, rubbish, and refuse shall be disposed of as specified in Section 02420, OFF-SITE DISPOSAL.
E. All vehicles, equipment, facilities, and construction aids shall be maintained in good working condition for the intended use.
F. The Contractor shall maintain all permanent and temporary fences in a condition satisfactory to the Engineer.
G. The Contractor shall perform and maintain environmental protection at all times as described in Section 01560, ENVIRONMENTAL PROTECTION.

H. All access roads, parking and laydown areas, drainage features, and work areas shall be maintained and kept in condition for their intended use, including periodic cleaning or regrading, as necessary.

## 3.3 FINAL CLEANING

A. Prior to completion of the Work, the Contractor shall conduct an inspection of the entire site and certify to the Engineer that the entire site is clear of all waste materials, rubbish, and debris.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. The Contractor shall perform surveys to the extent specified herein to set equipment, place features, determine required lines and grades, and to document completion of work.

### 1.2 REFERENCES

[Not used.]

### 1.3 SUBMITTALS

A. Prior to the start of any survey work, submit the name, address, State registration number, years of experience, and telephone number of the Land Surveyor and other persons proposed for survey-related duties to the Engineer for approval. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified. Include a description of the survey equipment and staking method to be used to perform the survey work.

B. Surveyor shall submit a copy of the field notebook, reduced survey notes, and calculations within fifteen (15) working days after work has been performed.

C. Surveyor shall provide AutoCAD, Civil 3D, and LDD electronic files or xml files, as appropriate, for the project on CD, and provide a data file of all points surveyed using PNEZD format (point number, northing, easting, elevation, and description). For all surfaces built, provide a list identifying the names of each surface with associated descriptions and names of point layers, point groups, breaklines, boundaries, and all other objects used to build each surface. The surveyor shall submit a list of all layers added to the drawing with layer names and descriptions for each layer and any other associated external references (xrefs) and/or third party files that support the drawing.

1. The AutoCAD file shall be developed on a 1:1 basis, with actual distances equal to "AutoCAD" distances. The file shall be developed with the standard unit being decimal feet.
2. The AutoCAD file shall have a separate layer for a border and title block, which shall contain the project name as well as the name of the surveying firm that performed the survey and prepared the drawing.
3. A "Notes" layer shall be included. The notes layer shall identify the dates of the survey, control points and benchmarks used, and any other information that the surveyor deems pertinent.
4. Each contour of a constant elevation shall be included as a separate polyline with the "z" coordinate set equal to that elevation. Major and minor contours shall be on separate layers.

D. An ASCII (ANSI) text file containing a listing of all the points including description, northing, easting, and elevation shall be submitted on CD.

E. Surveyor shall submit survey data for all wells (in table format) listing Well ID, Northing, Easting, and Top of Casing Elevation on CD.

F. The AutoCAD model space drawing shall be plotted in hardcopy on sheets size twenty-two inches by thirty-four inches (22" x 34") at an appropriate scale. Five (5) copies shall be submitted. Of the sets submitted, one (1) set shall bear the seal and signature of the professional surveyor.

G. Upon request by the Engineer, submit documentation verifying accuracy of the survey work.

H. Submit at the completion of each phase of work requiring services of the Surveyor certificates signed by the Surveyor stating that elevations and locations of site construction features and depths of excavation are in conformance, or nonconformance, with Design Documents.

## 1.4 EXPERIENCE OF PERSONNEL

A. The Contractor's surveyor shall also have a minimum of two (2) years of experience in construction surveying, and layout and maintenance of record construction drawings, with a record of performing horizontal and vertical control requirements as stated in this section.

B. Instrument operator(s) shall have one (1) year cumulative experience in operating each type of surveying instrument or equipment.

C. All work shall be under the responsible charge of a professional surveyor currently licensed in the State of Illinois.

D. Plan for, and ensure that, all personnel comply with the basic provisions of the Occupational Safety and Health Administration (OSHA) Standards (29 Code of Federal Regulations [CFR] 1910) and General Construction Standards (29 CFR 1926). All personnel must also comply with all other applicable federal, state, or local laws and regulations. Prepare and implement a hazard communication program meeting OSHA 29 CFR 1910.1200.

E. The Contractor is responsible for all the surveying done at the site.

## 1.5 ACCURACY

A. The Contractor shall complete all surveying to the following accuracy:

  a. Traverse surveys shall be completed to Federal Geodetic Control Subcommittee (FGCS) Third Order, Class One Standards and have an unadjusted closure of 1 in 10,000 after azimuth adjustment. Unadjusted azimuth closure shall not exceed three (3.0) seconds per station.

  b. Vertical control surveys shall have an unadjusted closure of seventeen-one-thousandths (0.017) feet multiplied by the square root of the control traverse distance in miles. This is consistent with FGCS First Order requirements.

  c. All traverses and control surveys shall be adjusted.

  d. Unless otherwise indicated on the attachment to this section, all points on a topographic survey shall be accurate to within a one-half- (0.5-) foot radius horizontally. Ground surface shots shall be accurate to within one-tenth (0.1) foot vertically.

## 1.6 DATUMS

A. Basis of bearing and coordinates (horizontal datum) shall be North American Datum of 1983 (NAD83), Illinois State Plane Coordinate system (SPCS), Illinois East 1201 Zone, International Feet.

B. Vertical datum for topographic survey shall be National Geodetic Vertical Datum (NGVD) 88, Units in Feet.

## 1.7 LAYOUT SURVEYING AND STAKING

A. All work performed shall be in conformance with the lines, grades, slopes, cross sections, profiles, and dimensions as shown on the Design Drawings and in a manner consistent with accepted practices.

B. The Contractor shall lay out work from the established control points, benchmarks, and baselines indicated on the Design Drawings and make all related measurements. The Contractor shall furnish all stakes, templates, platforms, equipment, tools, materials, and labor as may be required in laying out the Work from the established control points, benchmarks, and baselines..

C. The Contractor shall not deviate from the approved Design Drawings, unless approved in writing by the Engineer.

D. All construction staking shall be inspected by the Engineer prior to construction.

## 1.8 DOCUMENTATION

A. All data obtained during a survey shall be permanently recorded. A field notebook shall be maintained noting location, survey-crew members, dates, times, weather, field sketches, and other pertinent data (e.g. computer calculations or coordinates used to verify survey accuracy, closure notes, etc.).

B. Data recorded electronically shall be preserved on a CD. A hard copy of all electronically obtained data shall be maintained.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

A. Layout staking and final survey shall be performed by a professional land surveyor with experience as detailed in Paragraph 1.4. Local survey control is not required to be performed by a professional land surveyor.

B. The Contractor shall layout the locations for new site features including but not limited to the following: extraction wells; monitoring wells; and building corners.

C. Flagging, lath, and/or high visibility paint shall be used for field layout. Lath shall be clearly labeled with coordinate, elevation, and item descriptions. Offset lath shall be placed, as necessary and as directed by the Engineer.

D. For layout coordinate information, the Engineer shall provide the Contractor with electronic copies of all applicable Design Drawings developed in Real World Coordinates.

E. The Contractor shall maintain local survey control during all excavation for piping and structures, placement of materials and the installation of the piping and structures. During the construction phase, coordinates and elevations will be obtained for bottom of excavations and top of piping and structures. The coordinate and elevation information will be recorded electronically and shall be preserved on a CD. Daily electronic data collection will be forward to the Contractor and the Engineer. A hard copy of all electronically obtained data shall be maintained.

F. After completion of all site work, a final survey of the site shall be performed to document construction locations of all site features including but not limited to the following: extraction wells at ground surface and top of inner casing; monitoring wells at ground surface and top of inner casing, manholes at cover center and structure bottom, and building corners.

*** END OF SECTION ***

## SECTION 02100
## MOBILIZATION AND SITE PREPARATION

## 1.0 GENERAL

### 1.1 SUMMARY

A. Furnish and mobilize all equipment and materials required to prepare the site and complete all work as specified herein prior to beginning site activities.

### 1.2 RELATED WORK

A. Section 01320 – Construction Schedules.
B. Section 01330 – Contractor Submittals.
C. Section 01340 – Construction Operations Plan.
D. Section 01350 – Contractor Site Safety Plan.
E. Section 01510 – Temporary Construction Trailer.
F. Section 01520 – Temporary Utilities.
G. Section 01570 – Control and Regulation of Traffic.
H. Section 01580 – Existing Utilities and Subsurface Features.
I. Section 01800 – Site Maintenance.

### 1.3 SUBMITTALS

A. Indicate on a site layout plan the location of all work areas, storage areas, staging areas, loading/unloading areas, field office, etc.
B. Refer to Section 01330, CONTRACTOR SUBMITTALS, for a list of submittals that must be submitted before mobilization and site work will be permitted.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

### 3.1 INSTALLATION

A. All facilities, equipment, and materials shall be mobilized to the site following approval of the COP (Section 01340, CONSTRUCTION OPERATIONS PLAN) and review of CSSP (Section 01350, CONTRACTOR SITE SAFETY PLAN), as specified herein. Mobilization will not be permitted until the COP has been approved by Engineer and/or Agency.
B. The Contractor shall clear the designated work areas and access roads of all vegetation and debris where needed.
C. The Contractor shall install field office structure(s) as specified in Section 01510, TEMPORARY CONSTRUCTION TRAILER and make all temporary utility connections as specified in Section 01520, TEMPORARY UTILITIES.
D. The Contractor shall clear all rubbish as specified in Section 01800, SITE MAINTENANCE.

E. Mobilize equipment and materials in accordance with the construction schedule (Section 01320, CONSTRUCTION SCHEDULES).

## 3.2 PROTECTION

A. Protect existing features to remain as part of final site features.
B. Protect groundwater monitoring wells and fences from damage.
C. Protect above- and/or below-grade utilities, refer to Section 01580, EXISTING UTILITIES AND SUBSURFACE FEATURES.
D. Repair damage.
E. Deliveries shall be made according to Section 01570, CONTROL AND REGULATION OF TRAFFIC.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for handling of contaminated material.
B. Contact with contaminated materials is anticipated during drilling activities associated with extraction well and monitoring well construction.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01350 – Contractor Site Safety Plan.
C. Section 01560 – Environmental Protection.
D. Section 01580 – Existing Utilities and Subsurface Features.
E. Section 02410 – Transportation.
F. Section 02420 – Off-Site Disposal.

### 1.3 REFERENCE STANDARDS

A. 40 CFR 302, Designation, Reportable Quantities, and Notification
B. 29 CFR 1926, Safety and Health Regulations for Construction

### 1.4 SUBMITTALS

#### 1.4.1 Work Plan

A. As part of the Construction Operations Plan, the Contractor shall submit the following before the disturbance of contaminated materials shall commence:
1. Schedule of activities.
2. Storage methods and locations for contaminated material.
3. Decontamination procedures.
4. Spill contingency plan.

#### 1.4.2 Permits

A. The Contractor shall obtain required federal, state, and local permits for excavation and storage of contaminated material.

### 1.5 AIR EMISSIONS

A. Air emissions shall be monitored and controlled in accordance with Section 01560, ENVIRONMENTAL PROTECTION and Section 01350, CONTRACTOR SITE SAFETY PLAN.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

### 3.1 EXISTING STRUCTURES AND UTILITIES

A. Refer to Section 01580, EXISTING UTILITIES AND SUBSURFACE FEATURES.

### 3.2 CONTAMINATED MATERIAL STORAGE

A. Material shall be placed in temporary storage immediately after excavation. The following describe acceptable methods of material storage:
   1. Storage units shall be in good condition and constructed of materials that are compatible with the material to be stored.
   2. If multiple storage units are required, each unit shall be clearly labeled with an identification number, and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

#### 3.2.1 Temporary Stockpiles

A. Temporary stockpiles shall be constructed to isolate stored contaminated material from the environment. Stockpiles shall be constructed to include:
   1. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of twenty (20) mils.
   2. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than one-half (0.5) inch in diameter and any other object(s) that could damage the membrane.
   3. Geomembrane cover shall be free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of ten (10) mils. The cover material shall be anchored or ballasted to prevent it from being removed or damaged by wind.
   4. The liner system shall be sloped to allow collection of leachate.

#### 3.2.2 Roll-Off Units

A. Roll-off units used to temporarily store contaminated material shall be watertight. A cover shall be placed over the unit to prevent precipitation from contacting the stored material.

## 3.3 TRANSPORTATION AND DISPOSAL REQUIREMENTS

A. Off-site transportation and disposal of contaminated material shall be in accordance with Sections 02410, TRANSPORTATION, and 02420, OFF-SITE DISPOSAL.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SUMMARY

A. The Contractor shall provide all equipment, materials, and personnel necessary to abandon in place any damaged or obsolete extraction wells, open boreholes, open piping or conduit.

B. The Contractor shall provide all equipment, materials, and personnel necessary to remove protective casings, concrete pads, and protective bullards of abandoned monitoring wells.

### 1.2 RELATED WORK

A. Section 01340 – Construction Operations Plan.

B. Section 02300 – Earthwork.

### 1.3 SUBMITTALS

A. As part of the Construction Operations Plan (Section 01340) or under separate cover (submitted prior to well abandonment work), describe the proposed abandonment techniques to be utilized by the Contractor for each item specified in this section.

B. Illinois Department of Public Health reporting, as required.

## 2.0 PRODUCTS

### 2.1 BENTONITE GROUT

A. Bentonite used for grouting shall be a high-solids granular sodium bentonite mixed according to the manufacturer's directions, having a minimum mud weight of at least nine-and-one-half (9.5) pounds per gallon, and containing at least twenty percent (20 %) solids. Mixing methods should be used that prevent the slurry from being excessively lumpy.

### 2.2 UNHYDRATED BENTONITE

A. Bentonite used in an unhydrated form shall be sodium bentonite granules, pellets, or chips.

## 3.0 EXECUTION

### 3.1 GENERAL

A. All borehole and well abandonment shall comply with Illinois Department of Health (IDPH) regulations. Monitoring well closure reports will be filed by the Contractor.

B. Before any well or pipe abandonment, the Engineer and Contractor shall verify that the well or pipe to be abandoned has been located and tagged/marked for removal.

C. All excavation procedures used during abandonment activities shall be conducted in accordance with Section 02300, EARTHWORK.

## 3.2 BENTONITE GROUT

A. Prior to placement of grout, the grout slurry weight shall be measured according to American Society for Testing and Materials (ASTM) Test Method D-4380-84. Grout slurry shall not be placed until the grout slurry weight is within ten percent (10%) of the weight specified in Subpart 2 of this Section.

B. The grout slurry shall begin at the bottom of the well or pipe and extend to within six (6) inches of the existing ground surface, filling in all voids. Six (6) inches of topsoil shall be restored in accordance with Section 02300, EARTHWORK.

C. Grout slurries shall be placed through a side-discharge tremie pipe by gravity flow or by pumping to ensure positive displacement without bridging. The discharge end of the tremie pipe shall remain submerged in the grout throughout the grouting operation.

## 3.3 UNHYDRATED BENTONITE

A. In the event that leachate is encountered at the well or pipe bottom, bentonite granules, pellets, or chips shall be used in lieu of grout slurry (within the leachate filled portion only).

B. Pour rate shall be three (3) minutes or slower per fifty- (50-) pound sack.

C. A sounding or tamping tool shall be used during pouring to measure fill-up rate and to break up possible bridges or cake formation.

D. Unhydrated bentonite shall only be placed up to the water surface, with grouting (see Subpart 3.2, above) to be used to fill the remainder of the well or pipe.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. The contractor shall provide all equipment, materials, and personnel necessary to dismantle/demolish the following items as shown on the Drawings and described herein:
   1. Existing one (1) inch header piping for EW01 and EW03.
   2. Existing manifold system from the header connections to the second bend along the east wall of the ISCA P&T building.
   3. Pads and riser piping as related to Section 02215, Well Abandonment.

### 1.2 RELATED WORK

A. Section 02215 – Well Abandonment.
B. Section 02300 – Earthwork.
C. Section 02410 – Transportation.
D. Section 02420 – Off-Site Disposal.

### 1.3 REFERENCE STANDARDS

[Not used.]

### 1.4 SUBMITTALS

[Not used.]

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

### 3.1 GENERAL

A. Debris shall be transported and disposed according to Sections 02410, TRANSPORTATION and 02420, OFF-SITE DISPOSAL.
B. All excavation procedures used during demolition shall be in accordance with Section 02300, EARTHWORK.
C. Prior to any demolition the Engineer and Contractor shall verify that the structures or items to be demolished have been tagged/marked for demolition.
D. Conform to the following regulatory requirements:
   1. Applicable regulatory procedures when discovering hazardous or contaminated materials.
E. Any item that is contaminated and that leaves the site of work shall be in a form that makes it unusable by anyone.
F. Do not burn materials on site.

G. Do not cut contaminated structures with torches or other high heat devices. Metal may be cut with metal saws using oil or other appropriate fluid to keep cut relatively cool.

## 3.2 TRANSPORTATION AND DISPOSAL

A. Refer to Section 02410, TRANSPORTATION and Section 02420, OFF-SITE DISPOSAL.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. Structural Earthwork: This section specifies the earthwork materials and methods (e.g., excavation, backfilling, trenching, hauling, stockpiling, placing, grading and compaction) required to perform the following:
   1. Subgrade preparation for the building foundation.
   2. Subgrade preparation for repair of paved surfaces.
   3. Other work incidental to earthwork shown on the Drawings or required to complete the Work.

B. Trenching: Specifically, the Work shall cover the excavation, backfilling, and compacting for:
   1. Installation of force main piping and electric conduit.

C. Material specifications for common backfill, pipe bedding, and drainage course for slab on grade.

D. Earthwork shall proceed in a method consistent with the alignments, grades, and cross-sections shown or indicated on the Drawings, detailed in the Specifications, or required to complete other Work as shown, described, or otherwise required under this Contract.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01340 – Construction Operations Plan.
C. Section 01350 – Contractor Site Safety Plan.
D. Section 01450 – Quality Control.
E. Section 01560 – Environmental Protection.
F. Section 01580 – Existing Utilities and Subsurface Features.

### 1.3 REFERENCE STANDARDS

A. Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction [IDOTSPEC] (2007).

B. American Society for Testing and Materials (ASTM) Standards:
   1. ASTM C 136: Standard Test Method for Sieve Analysis for Fine and Coarse Aggregates.
   2. ASTM D 422: Standard Test Method for Particle-Size Analysis of Soils
   3. ASTM D 1557 (1991; R1998) Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
   4. ASTM D 2487: Standard Test Method for Classification of Soils for Engineering Purposes.
   5. ASTM D 2922 (1996) Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).

6. ASTM D 3017 (1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ASTM D 5084-03 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
8. ASTM D 3550-01 Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling.

## 1.4 SUBMITTALS

A. The Contractor shall submit all required items under provisions of Section 01330, CONTRACTOR SUBMITTALS, and as described herein.

B. The Contractor shall obtain required federal, state, and local permits for excavation and storage of contaminated material.

C. Air emissions shall be monitored and controlled in accordance with Section 01560, ENVIRONMENTAL PROTECTION.

D. The Contractor shall submit an Earthwork Plan as part of the COP (Section 01340, CONSTRUCTION OPERATIONS PLAN), describing the proposed methods and means and construction sequencing to be used to perform the Work. The plan shall include, but not be limited to, details of the Contractor's plan and equipment to accomplish the following Work activities:
   1. Material and equipment storage;
   2. Establishment of haul routes;
   3. Soil excavation, placement, spreading, grading, and compaction procedures with a list of equipment proposed to complete the Work;
   4. Excavation shoring, if required;
   5. Dewatering and water management, if necessary;
   6. Stockpiling;
   7. Quality control measures and testing procedures.

E. Samples:
   1. For each proposed import earthen material, submit name, location, and contact information for each source as soon as source is determined. At the Engineer's option, the Engineer shall either collect a sample of each material from each source or request the Contractor to submit a representative sample (five [5]-pounds minimum) from each source in an airtight container. Samples may be analytically tested by the Engineer to verify materials are free of contamination. Materials shall not be delivered to the site until material test results have been approved by the Engineer.

F. Material test reports:
   1. Qualifications and/or certification of the testing laboratory as described in Section 01450, QUALITY CONTROL shall be submitted to the Engineer for approval before samples are submitted for testing.
   2. The Contractor shall provide all test results fifteen (15) calendar days prior to commencement of subgrade work and/or importation of fill material to the Site.

## 1.5 QUALITY ASSURANCE

A. Prior to placement of earthen materials, the Contractor shall conduct all specified tests. The test results shall be submitted to the Engineer for approval.

## 1.6 CONTRACTOR RESPONSIBILITY

A. The Contractor shall carefully coordinate, schedule, and implement the Work as required for the coordinated installation of concrete formwork or asphalt pavement.
B. The Contractor shall provide a sufficient number of competent personnel experienced in this type of construction and able to carry out the Work in an efficient and successful manner. Commit these experienced personnel to the Project for the duration of the Work.
C. The Contractor shall have adequate materials and functioning equipment at the Site so that the Work can proceed uninterrupted.
D. The Contractor shall provide construction equipment that is in good operating condition, is suitable in size to efficiently accomplish the Work, and meets applicable federal and state safety codes and regulations.

## 2.0 PRODUCTS

## 2.1 GENERAL

A. All soils specified hereinafter shall meet the following requirements.
   1. All soils shall be free of organic matter, except Common Backfill placed within six (6) inches of the final grade may contain up to ten percent (10%) small twigs, small roots, and other small organic matter.
   2. All soils shall contain no rocks greater than two-thirds (2/3) of the compacted lift thickness.
   3. All soils shall be clean fill. Clean fill means material consisting of soil, rock, concrete, brick, building block, tile or asphalt paving, which do not contain contaminants that could adversely impact the waters of the State or public health.

B. Soils excavated from the site may be stockpiled and used as fill. If any soil so excavated is thought not to be clean fill, as defined above, the condition shall be brought to the immediate attention of the Engineer for action.

## 2.2 COMMON BACKFILL

A. Excavations greater than six (6) inches in depth shall be backfilled immediately or fenced refer to Section 01610, CONSTRUCTION AIDS.
B. Within pipe trenches, complete pressure testing before backfilling per Section 15050, BASIC MATERIALS AND METHODS FOR PIPING.
C. Place and compact backfill in excavations after completing the following:

1. Verifying with the Engineer that the excavation is to be backfilled.
2. Removing trash and debris.
3. Removing temporary shoring, bracing, and sheeting.

D. Common Fill shall be placed at all areas where fill is required but not otherwise specified. Common Fill shall be taken from soils generated during trenching and excavating activities and stockpiled on site.

E. When material is not available on site use: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols. Satisfactory soils shall be free of rock or gravel larger than three (3) inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter, and shall be maintained within three percent (3%) of optimum moisture content at time of placement and compaction.

## 2.3 PIPE BEDDING

A. Excavate all pipe trenches to below the regional frost line.

B. Grade bottoms of trenches to provide uniform support for each section of pipe after pipe bedding placement.

C. A minimum two (2) inches of pipe bedding shall be placed beneath pipes. Backfill bedding to top of pipe shall be compacted to ninety-five percent (95%) of ASTM 698 maximum density. Plastic piping shall have bedding to spring line of pipe.

D. The material shall be clean, non-plastic, natural, sub-angular, and silica-based.

E. The material shall be free from organic material, mica, loam, clay, or other deleterious or foreign matter.

F. Fine Aggregate consisting of sand, stone sand, stone screenings, chats, wet bottom boiler slag, slag sand or granulated slag sand meeting the specifications of IDOTSPEC Article 1003.04, gradation FA 6 as shown in Table 02140-1.

**Table 02300-1**
**FINE AGGREGATE GRADATIONS FOR TRENCHES**
**BELOIT CORPORATION SITE**
**ROCKTON, ILLINOIS**

| Sieve Size Percent Passing | | | |
|---|---|---|---|
| Gradation Number. | No. 4 | No. 100 | No. 200 |
| FA 6 | 92±8 | 20±20 | 15±15 |

## 2.4 DRAINAGE COURSE FOR SLAB ON GRADE

A. The material shall be clean, non-plastic, natural, sub-angular, and silica-based.

B. The material shall be free from organic material, mica, loam, clay, or other deleterious or foreign matter.

C. Drainage course: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57 (fifty-seven); with one-hundred percent (100%) passing a one-and-one-half (1-1/2-) inch sieve and zero (0%) to five percent (5%) passing a No. 8 (eight) sieve, as shown in Table 02140-21.

| Table 02300-2<br>COURSE AGGREGATE GRADATIONS FOR DRAINAGE COURSE<br>BELOIT CORPORATION SITE<br>ROCKTON, ILLINOIS | | |
|---|---|---|
| Sieve Size<br>Percent Passing | | |
| Gradation Number. | 1-1/2 inch | No. 8 |
| Size 57 | 100 | 2.5±2.5 |

## 3.0 EXECUTION

### 3.1 PREPARATION

A. Protect structures, utilities, pavements, and other facilities that will remain from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations, refer to Section 01580, EXISTING UTILITIES AND SUBSURFACE FEATURES.

B. Complete site clearing as required.

C. Protect structural subgrade and foundation soils against freezing temperatures and frost. Provide protective insulating materials as necessary.

D. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties, roadways, and walkways, refer to Section 01560, ENVIRONMENTAL PROTECTION.

### 3.2 WET WEATHER EARTHWORK

A. Provide and operate equipment adequately to keep all excavations and trenches free of standing water at all times. Prevent surface water and groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

C. If dewatering is necessary, dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Dewatering shall be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation. Construct with proper sand filters to prevent drawing of finer-grained soil from the surrounding ground. Dispose of water in a manner that will not damage adjacent property.

D. If earthwork is to be performed or borrow material is placed in wet weather or under wet conditions when control of soil moisture is not possible, the following shall apply:

1. Earthwork shall be accomplished in small sections to minimize exposure to wet weather. Excavations or the removal of unsuitable material shall be followed immediately by the placement and compaction of a suitable thickness of clean fill.
2. The ground surface in the construction area shall be sloped and sealed with a smooth drum roller to promote rapid runoff of precipitation, to prevent surface water from flowing into excavations, and to prevent ponding of water.
3. No soil shall be left uncompacted so it can absorb water. Soils that become too wet for compaction shall be removed and replaced with drier materials.

## 3.3 HAULING AND STOCKPILING

A. Stockpiles shall be segregated from one another.
B. Side slopes shall not be steeper than 1V on 2H. See Section 01560, ENVIRONMENTAL PROTECTION for erosion control requirements.
C. When removing material from stockpiles, excavate it in a systematic manner. The Contractor shall prevent mixing with other materials (e.g., do not mix stockpiled sand with existing site soils).

## 3.4 COMMON EXCAVATION

A. Contractor shall inform and satisfy the Agency as to the character, quantity, and distribution of all material to be excavated.
B. Excavation of every description, classification, and of whatever substances encountered within the limits of the project shall be performed to the lines and grades necessary, as indicated on the drawings.
C. The Contractor shall identify and verify with the plans, the required lines, levels, contours, and datum locations. Any discrepancies shall be immediately reported to the Engineer.
D. Common excavation material shall be moved with the use of mechanical or hand-operated equipment, such as shovels, loaders, backhoes, bulldozers, excavators, graders, scrapers, trenchers, rippers, etc., but shall not require drilling and blasting or drilling and line breaking. Excavation by sluicing method will not be permitted.
E. Excavated material shall not be placed adjacent to the excavation until side slopes and excavation support systems have been designed, constructed, and maintained for anticipated loads. Material stored adjacent to the excavation shall be supported back from the edge of the excavation as required by the Occupational Safety and Health Administration (OSHA).
F. Excavation shall be done in dry weather when possible. Temporary drains and drainage ditches shall be installed to intercept or direct surface water, which may affect the promotion or condition of the Work. Contractor shall grade top perimeter of excavation to prevent surface water from entering the excavation. Contractor shall assume all responsibility for removal, handling, treatment, and disposal of any surface water that enters the excavation in accordance with appropriate local, state,

and federal regulations. Contractor will also be required to remove and replace any aggregate materials rendered unstable as a result of such run-on of surface water.

G. Contractor shall provide a method(s) to control dust around the excavations in accordance with the requirements of Section 01560, ENVIRONMENTAL PROTECTION.

H. Contractor shall excavate materials from stockpiles in a systematic manner. The stockpiles shall be constructed in such a way to prevent siltation, erosion, and general loss of the materials. Stockpile areas shall be returned to pre-construction conditions prior to demobilization from the site.

I. Contractor shall make safe all work areas. Contractor shall cease work in an area until all unsafe conditions have been made safe. Refer to Section 01350, CONTRACTOR SITE SAFETY PLAN.

J. Contractor shall provide safe access to the excavation for any inspections that may be required during excavation activities.

K. Keep placement surfaces free of water, debris, organic matter, and foreign material during placement and compaction of fill and backfill materials. No fill shall be placed on frozen surfaces.

## 3.5 PIPE TRENCHES

A. Trench Excavation.

1. Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all local and national standards for safety. Open only as much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.
2. Where trench walls are stable or supported, provide a width sufficient, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the pipe and trench wall must be wider than the compaction equipment used in the pipe zone. Minimum width shall be not less than the greater of either the pipe outside diameter plus sixteen (16) inches or the pipe outside diameter times one and one-quarter (1.25), plus twelve (12) inches. In addition to safety considerations, trench width in unsupported, unstable soils will depend on the size and stiffness of the pipe, stiffness of the embedment and in-situ soil, and depth of cover.
3. When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the pipe and its embedment is maintained throughout installation. Ensure that sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstructions that restrict driving of sheeting.

B. Dewatering

1. Do not lay or embed pipe fittings in standing or running water. At all times prevent runoff and surface water from entering the trench.
2. When water is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to

provide a stable trench bottom. Use, as appropriate, sump pumps, well points, deep wells, geofabrics, perforated underdrains, or stone blankets of sufficient thickness to remove and control water in the trench. When excavating while depressing ground water, ensure the ground water is below the bottom of cut at all times to prevent washout from behind sheeting or sloughing of exposed trench walls. Maintain control of water in the trench before, during, and after pipe system installation and until embedment is installed and sufficient backfill has been placed to prevent flotation of the pipe or fitting. To preclude loss of soil support, employ dewatering methods that minimize removal of fines and the creation of voids in in-situ materials.

3. Any water from dewatering activities shall be handled according to Section 01562, WASTEWATER MANAGEMENT.

## 3.6 MATERIAL PLACEMENT AND COMPACTION

A. General
   1. Accurately and smoothly spread the materials over the specified areas to the lines, grades, thicknesses, and slopes, encountered before excavation or as directed by the Engineer.
   2. Round tops and bottoms of all slopes.
   3. Shape slopes to gradually transition into grade adjustments without noticeable breaks.
   4. Moisture condition the earthen layer materials, as applicable, to or near the optimum moisture content.
   5. Use small portable compactors within two (2) feet of any utilities, wells, pipes, or pavement.
   6. Perform compaction tests of type and frequency described in the Field Quality Control paragraph of this Section.

B. Structural Backfill
   1. Subgrades for structures and concrete slabs shall have the top twelve (12) inches compacted to ninety-five percent (95%) of its modified Proctor maximum dry density as determined by ASTM D1557. Compact fill and backfill to ninety-five percent (95%) as determined by ASTM D1557.
   2. Subgrades for paved areas shall have the top twelve (12) inches compacted to ninety-five (95%) of its modified Proctor maximum dry density as determined by ASTM D1557. Compact fill and backfill to ninety-five percent (95%) as determined by ASTM D1557.
   3. Compaction, shall begin immediately after the material is spread.

C. Common Backfill
   1. Existing soils to develop subgrade elevations shall be placed in lifts with a maximum thickness of eight (8) inches.
   2. Compact, as necessary, to achieve ninety-five percent (95%) of maximum density according to ASTM D1557. Compaction at other locations shall be as specified hereinafter.
   3. Compaction, shall begin immediately after the material is spread.

D. Pipe Bedding
   1. Placement shall be of a uniform thickness, free of ruts and irregularities.
   2. Compact each lift, as necessary, to ninety percent (90%) of maximum density per ASTM D1557.
      a. Compaction, if necessary, shall begin immediately after the material is spread.
      b. Apply additional water over the materials as necessary to achieve proper compaction.

## 3.7 PROOF ROLLING

A. Proof Rolling shall be conducted on exposed, structural subgrades free of surface water.
B. When proof rolling, the building subgrade shall be considered to extend five (5) feet beyond the building lines and one-half (1/2) of the passes made shall be in a direction perpendicular to the other passes.
C. Rutting and pumping of material shall be undercut and replaced with backfill material.

## 3.8 FIELD QUALITY CONTROL – COMPACTION TESTING

A. For each layer that has compaction criteria, perform compaction testing per ASTM D2922 prior to placing subsequent layers.
B. The Contractor shall subcontract out the testing to an independent company in which it has no financial interest.
C. See Part 1.4, above, for submittal requirements.
D. The Engineer will choose the test locations.
E. When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1556 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1556 density test at the start of the job, and for every ten (10) ASTM D 2922 and ASTM D 3017 density tests thereafter. Test at randomly selected locations every two thousand (2,000) square feet of existing grade infills for structures and concrete slabs, and every two thousand five hundred (2,500) square feet for other fill areas and every two thousand (2,000) square feet of subgrade in cut.
F. Special care shall be taken to assure underlying materials are not damaged during compaction testing. Any damage to these items shall be repaired at the Contractor's expense.
G. Record the following for each test (to be submitted to the Engineer): 1) the location and elevation; 2) the material description and appropriate compaction control standard; 3) the moisture content, dry density, and percent of the referenced compaction standard; and 4) the date, time, weather conditions, and all other pertinent data.

## 3.10 GRADING

A. Uniformly grade areas to a smooth surface free from irregular surface changes.
B. Provide a smooth transition between adjacent existing grades and new grades.

## 3.11 PROTECTION

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
B. Repair and reestablish grades where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section includes preparing and loading vehicles, inspection and record keeping prior to transport, and transportation of waste materials to off-site TSD facilities.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 02111 – Excavation and Handling of Contaminated Materials.
C. Section 02420 – Off-Site Disposal.

### 1.3 REFERENCE STANDARDS

A. 40 CFR 262, Standards Applicable to Generators of Hazardous Waste.
B. 40 CFR 263, Standards Applicable to Transporters of Hazardous Waste.
C. 49 CFR 171, General Information Regulations and Definitions.
D. 49 CFR 172, Hazardous Materials Tables and Hazardous Materials Communications Regulations.
E. 49 CFR 173, Shippers—General Requirements for Shipments and Packaging.
F. 49 CFR 174, Carriage by Rail.
G. 49 CFR 176, Carriage by Water.
H. 49 CFR 177, Carriage by Public Highway.
I. 35 IAC 809, Special Wastes Hauling Regulations.
J. All other applicable federal, state, and local regulations.

### 1.4 SUBMITTALS

A. The Contractor shall submit, as part of the Construction Operations Plan, procedures, equipment, and methods for handling material on site, temporarily storing materials on site, loading, and transporting material to off-site disposal facility(ies) including haul routes. The plan shall also include spill contingency actions.
B. The Contractor shall submit, as part of the Construction Operations Plan, procedures, equipment, and methods for transporting material to and from the site.
C. The Contractor shall prepare and provide the Agency and Engineer with records for each shipment of material to and from the site.
D. The Contractor shall prepare and provide the Agency with waste shipment records for each shipment of material from the site.
E. The Contractor shall provide documentation to the Agency that demonstrates that the proposed transporters are properly licensed and are in full compliance with the conditions of their licenses.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

### 3.1 VEHICLE LOADING AND PREPARATION

A. Provide all equipment, personnel, and facilities necessary to load waste materials in accordance with the regulatory requirements listed in Subpart 1.2 and in accordance with the regulations of those states through which the Contractor plans to transport materials.

B. Vehicles used to transport wastes shall be properly designed, equipped, and maintained to prevent leakage of waste materials, debris, and contaminated materials during transport.

C. Vehicle operators shall be trained in conformance with the Federal and State regulations for waste haulers (hazardous, special, and nonhazardous).

D. All vehicles hauling waste materials from the site shall be decontaminated prior to leaving the site. A written certification shall be provided to the Engineer for each subparagraph below stating that:
   1. No soil from the exclusion zone or the contamination reduction zone adheres to the vehicle (including tires and undercarrriage).
   2. The vehicle is not leaking or dripping liquids in any amount.
   3. The waste materials, debris, and contaminated materials are covered with a tarpaulin, or are otherwise completely enclosed so as not to cause or permit discharge from the vehicle.

E. Borrow material shall be handled and transported to the site in accordance with federal regulations and the regulations of those states through which the Contractor plans to transport the material.

### 3.2 SHIPMENT RECORDS

A. Prepare and provide the Engineer with waste manifests and/or other records for each shipment of wastes from the site.
   1. The Agency will provide a hazardous waste generator identification number for use on the manifest (where required).
   2. The Contractor shall place on the manifest all other required information and data to be supplied by both the waste generator and transporter and provide the Engineer with two (2) fully executed photocopies of each shipment manifested.
   3. Weigh each vehicle before and after loading waste materials. The net weight of loaded materials shall be used as the measure of hazardous waste for purposes of completing hazardous waste manifests.
   4. For hazardous wastes, two (2) photocopies of the manifests, signed by the receiving facility operator, shall be provided to the Engineer.

B. The Contractor shall provide mechanically imprinted weight tickets, from a state-approved certified scale, for all borrow material delivered to the site. One (1) photocopy of the U.S. Department of Transportation (DOT) shipping papers, signed by the source facility operator, shall be provided to the Engineer for each load delivered.

## 3.3 HAULING

A. Waste material shall not be transported from the site to an intermediate waste storage of transfer facility en route to the facility selected by the Contractor. Materials shall be hauled directly from the site to the final disposal facility.

B. Details of haul routes shall be submitted to the Engineer. See Section 02420, DISPOSAL, for Materials Handling Plan (MHP) requirements.

C. The Contractor shall be responsible for any and all actions to remediate spills in transit.

D. The Contractor shall be responsible for obtaining permits and authorizations necessary to use the selected shipping routes. Comply with restrictions imposed by local governmental agencies regarding use of the routes.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers the requirements for off-site disposal and/or recycling of waste materials.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 02111 – Excavation and Handling of Contaminated Material.
C. Section 02410 – Transportation.

### 1.3 REFERENCE STANDARDS

A. 40 CFR 261, RCRA Identification and Listing of Hazardous Wastes.
B. 40 CFR 262, Standards Applicable to Generators of Hazardous Wastes.
C. 40 CFR 263, Standards Applicable to Transporters of Hazardous Wastes.
D. 40 CFR 264, Standards for Owners and Operators of Hazardous Waste Treatment, Disposal, and Storage Facilities.
E. 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Disposal, and Storage Facilities.
F. 40 CFR 268, RCRA Land Disposal Restriction.
G. 35 Illinois Adm. Code Chapter G, Waste Disposal.

### 1.4 SUBMITTALS

A. The Contractor shall prepare a Materials Handling Plan (MHP), which describes Contractor operations, procedures, and methods for characterization, removal, transportation, and off-site disposal of liquids, solids, and drums. Provide equipment, materials, and personnel to remove and transport waste liquids, solids, and drums to off-site facilities and provide off-site treatment and/or disposal according to type of material as specified.
B. Submit for the Agency's review and approval, a letter of commitment from the disposal and salvage facilities. The facilities shall give assurance in writing that they will be open for business during the project duration, are properly licensed and in compliance with their licenses/permits, are in compliance with EPA's Off-Site Disposal Policy, and will accept the waste anticipated for this interim remedial action. Include the names, locations, and applicable state identification numbers.
C. Submit to the Engineer two (2) copies of records within thirty (30) days of activity. Provide written manifest verifying receipt of and quantity received (volumes and weights, as necessary) of each load at facility, and verification of proper disposal.
D. The Contractor shall submit to the Engineer a Certificate of Disposal/Destruction/Recycling for each load of waste transported from site.

## 1.5 DEFINITIONS

A. For the purposes of this project, wastes shall be considered all materials and items removed from the site except Contractor equipment and vehicles.

B. Non-hazardous waste refers to other waste material that does not meet the definition of RCRA hazardous waste as described in 40 CFR 261 or in applicable state or local regulations.

## 2.0 PRODUCTS

A. The products specified herein shall be leased or owned by the Contractor and will not become property of the Agency. All products specified herein shall be removed from the Work site when no longer needed.

## 3.0 EXECUTION

## 3.1 MEASUREMENT OF RECEIVED WASTE QUANTITIES

A. The Contractor shall document the weight of waste at the off-site disposal facilities, and shall provide copies of records of weights to the Agency and Engineer. These weight measurements shall be used for payment purposes. If a discrepancy exists the Agency will pay the lesser of the amount.

## 3.2 SOLID WASTE (HAZARDOUS AND NONHAZARDOUS)

A. Hazardous and non-hazardous solid wastes shall be disposed of in such a manner that the location (in a landfill or elsewhere) is documented and the wastes can be retrieved at a later date.

## 3.3 DISPOSAL IN A SECURE LANDFILL

A. Submit letters of commitment from landfill facilities at which the Contractor proposes to dispose of hazardous waste.

B. The landfill disposal facilities designated must comply with policies adopted by the EPA with respect to the off-site disposal of waste removed from Superfund sites.

1. The facility must have a RCRA permit of RCRA Interim Status for RCRA wastes, and EPA approval to accept TSCA wastes.
2. The facility must have been inspected by the appropriate Federal and State officials responsible for the RCRA or TSCA program within six (6) months prior to receipt of wastes under this Contract.
3. The facility must not have any significant RCRA violations or other environmental conditions that could affect its satisfactory operation.
   a. Significant violations include Class 1 RCRA violations as defined in EPA's RCRA Enforcement Response Policy, including but not limited to groundwater, closure, post closure, and financial violations.

b. Environmental conditions affecting the satisfactory operation of the facility include violations of State and/or Federal laws other than RCRA.
c. Under limited circumstances, the EPA administrator may allow disposal of hazardous substances at a RCRA facility having significant RCRA violations or other environmental conditions affecting satisfactory operation, providing that the facility owner or operator has entered into a consent order or decree to correct the problems, and disposal only occurs within the facility at a new or existing unit that is in compliance with RCRA requirements.

4. Landfill disposal must be in a unit meeting applicable RCRA minimum technical requirements (if RCRA waste is disposed of), or applicable TSCA standards (if TSCA waste is disposed of).
   a. Current RCRA minimum technical requirements for land disposal include the use of a double liner system.
   b. Under limited circumstances (low waste toxicity, mobility, and persistence), EPA may approve the use of a single-lined land disposal unit for RCRA wastes where use of such a unit adequately protects public health and the environment.

C. Provide the Engineer with the name, location, and applicable State and Federal identification numbers of the off-site facility to be used for landfill disposal of wastes.

D. The Contractor shall contact the EPA Regional Off-site Coordinator not more than one (1) week prior to waste disposal to determine status and assure that the selected site meets approval.

E. The Contractor shall perform any sampling and analyses required by the disposal facility.

## 3.4 DISPOSAL IN A MUNICIPAL OR SPECIAL WASTE LANDFILL

A. Weights of wastes to be disposed of in a municipal (general or demolition) landfill or special waste landfill shall be determined prior to off-site shipment using an on-site weigh station, unless measurement is performed at the disposal facility.

B. Before shipping any wastes to a landfill the Contractor shall perform any sampling and analyses required.

## 3.5 TREATMENT AND/OR DISPOSAL AT A TSD FACILITY

A. The Contractor shall provide to the Engineer in the MHP, details of proposed treatment/disposal of contaminated materials including TSD facilities to be used, scheduled deliveries to TSD facilities, and scheduled disposal operations.

B. The Contractor shall coordinate for truck and waste deliveries at each TSD facility to meet approved project schedule and for compatibility with temporary storage/staging space limitations on-site and availability of equipment or personnel for materials handling operations.

C. The contractor shall obtain a letter of agreement from each TSD facility. The letter shall include the facilities acceptance of the wastes and estimated quantities of waste, and the intended method of disposal to be used by the TSD facility for each waste shipment.

D. The Contractor shall ensure that acceptance has been obtained for each specific waste at an approved TSD facility, that the facility is properly permitted to accept the stated wastes, and that the facility provides the stated disposal services.

## 3.6 STEEL SALVAGE/REUSE

A. Unless otherwise specified, all steel waste material shall be salvaged at an Agency approved reclamation center.

## 3.7 WASTEWATER PRETREATMENT STANDARDS

A. Wastewater discharged to the Metropolitan Water Reclamation District of Greater Chicago (MWRD) shall meet the most current discharge limitations and sampling requirements.

B. It is the Contractors responsibility to ensure the discharged wastewater meets or exceeds pretreatment standards.

## 3.8 RECORDKEEPING

A. The Contractor shall originate and maintain complete records of handling, transport, delivery, and disposal of wastes.

B. If notification of any receipt of waste shipment at a TSD facility is not received by the Contractor as planned, immediately notify the Engineer and contact the facility to determine status of the shipment and to resolve the discrepancy.

*** END OF SECTION ***

SECTION 02610
EXTRACTION WELL CONSTRUCTION

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# 1.0 GENERAL

## 1.1 SUMMARY

A. Provide three new extraction wells (EW05. EW06 and EW07) including permitting, drilling, casing, well screen, filter packing, grouting, protection, development, and incidental related work complete and ready for operation.
B. Pneumatic fracturing will be used to increase aquifer permeability.

## 1.2 IDENTIFICATION

A. Locations of the extraction wells are shown on the Drawings.

## 1.3 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01550 – Equipment and Material Decontamination.
C. Section 01562 – Wastewater Management.
D. Section 02010 – Existing Utilities and Subsurface Features.
E. Section 02040 – Surveying.
F. Section 02111 – Excavation and Handling of Contaminated Material.
G. Section 02215 – Well Abandonment.
H. Section 02675 – Pneumatic Fracturing.
I. Section 03300 – Cast-in-Place Concrete.
J. Section 15050 – Basic Materials and Methods for Piping.
K. Drawings.

## 1.4 REFERENCE STANDARDS

A. ASTM A 312/A 312M (1995a) Seamless and Welded Austenitic Stainless Steel Pipes
B. ASTM C 136 (1996; Rev. A), Sieve Analysis of Fine and Coarse Aggregates.
C. ASTM C 150 (2002; Rev A), Portland Cement.
D. ASTM D 4750 (1987, R1993), Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well).
E. ASTM D 5092 (1990; Rev. 1995), Design and Installation of Ground Water Monitoring Wells in Aquifers.
F. ASTM D 5521 (1994), Development of Ground-Water Monitoring Wells in Granular Aquifers.
G. EPA 600/4-89/034 (1990), Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells.
H. EPA 570/9-75/001 (1975), Manual of Water Well Construction Practices.

## 1.5 SUBMITTALS

A. Material certificates, if applicable, for all construction materials, including casing, screen, sand, bentonite, and grout.

B. Copies of all permits, licenses, or other requirements necessary for execution of the work.
C. Borehole Logs. At a minimum, the logs should include the project name and location, well/boring designation, depth, description of all formations encountered (logged by the Driller from drill cuttings), and depth at which groundwater is encountered (as measured through the auger).
D. Installation Diagram. At a minimum, the diagram should include the project name and location, well designation, date and time of well installation, water level, construction materials, depth to screen, depth to top of filter pack, and depth to top of bentonite seal.
E. Well Development Records. Documentation should include: project name and location; well designation; date and time of well installation; date and time of well development; static water level from top of well casing before development and twenty-four (24) hours after development; field measurements of pH, temperature, and specific conductivity; depth of well from top of casing to bottom of well; screen length; description of development methodology; size/capacity of pump or bailer; pumping rate; and recharge rate.

## 2.0 PRODUCTS

### 2.1 GENERAL

A. Product material, size, and dimensions shall be as specified herein. Pipe sizes shall be commercial pipe sizes and are nominal dimension.
B. No bonding materials or lubricants shall be used on any casing or screen.
C. All equipment and materials shall be decontaminated prior to and following use as specified in Section 01550, EQUIPMENT AND MATERIAL DECONTAMINATION.

### 2.2 DELIVERY, STORAGE, AND HANDLING

A. Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation.
B. Store materials in on-site enclosures or under protective coverings. Store plastic piping under cover, out of direct sunlight. Store materials off the ground.
C. Keep insides of pipes and fittings free of dirt and debris.
D. Replace defective or damaged materials with new materials.

### 2.3 WELL CASING

A. Extraction well casing shall consist of eight (8) inch inside diameter (ID), type 304 stainless steel, the minimum wall thickness shall be schedule 40S meeting the requirements of ASTM A 312/A 312M, with flush threaded joint fittings.

## 2.4 WELL SCREEN

A. Extraction well screens shall consist of eight (8) inch ID, type 304 stainless steel, continuous slot, wire-wound design, the minimum wall thickness shall be schedule 40S meeting the requirements of ASTM A 312/A 312M, with flush threaded joint fittings.

B. Extraction well screens shall be the length shown on Drawings with a Number 10 (0.010 inch) slot size.

## 2.5 FILTER PACK

A. The filter pack shall consist of washed, sieved silica sand and shall be properly sized and graded for the surrounding soil and screen slot size, and shall be composed of round, waterworn sand, free of flat or elongated pieces, organic matter, or other foreign matter.

## 2.6 BENTONITE SEAL

A. Bentonite used shall be VolClay one-quarter (0.25) inch pellets or equivalent.

## 2.7 CEMENT GROUT

A. Cement grout shall consist of a mixture of Portland Cement Type I (ASTM C 150) and water in the proportion of not more than seven (7) gallons of approved water per bag (94 lbs.) of cement. Cement grout shall contain bentonite in the proportion of three percent (3%) by weight powdered (not pellets) bentonite to cement.

## 2.8 CONCRETE

A. As specified in section 03300, CAST-IN-PLACE CONCRETE. No reinforcement shall be used and batch strength shall be three thousand (3000) psi.

## 2.9 BOTTOM PLUGS

A. Provide a five (5) foot long flush threaded plug at the bottom of the well matching the specifications for well casing material.

## 2.10 ABOVEGROUND COMPLETIONS

A. Provide protective outer casing a minimum of eight (8) inches in diameter larger than the well casing diameter. A locking well cap shall be provided on top of the protective outer casing.

B. Provide four (4) steel pipe bollards having a minimum diameter of six (6) inches and a length of eight (8) feet for each well installed.

## 3.0 EXECUTION

### 3.1 GENERAL

A. Contractor is responsible for obtaining well construction permits.
B. Refer to Section 02010, EXISTING UTILITIES AND SUBSURFACE FEATURES for identifying all existing subsurface utilities and site features.
C. Well locations shall be laid out according to Section 02040, SURVEYING.

### 3.2 NEW WELL INSTALLATION

A. Well installation shall be in accordance with ASTM D 5092 and EPA 570/9-75/001, and as indicated herein. Borehole shall be stable and shall be verified straight before beginning installation.
B. Wells shall be drilled, pneumatically fractured, redrilled, and have the fractures re-developed according to Section 02675, PNEUMATIC FRACTURING.
C. When the well casing has been set at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be plugged during filter pack placement.
D. The filter pack shall be placed in the annulus between the augers and the well casing, and the augers shall be withdrawn as the filter pack is installed to ensure positive placement of the material. The filter pack shall be installed to extend above the screen a distance of two (2) feet. All backfilling should be done in two (2) foot or smaller increments as the augers are withdrawn to keep the borehole from collapsing around the well screen before the filter pack is complete.
E. Bentonite seal, consisting of bentonite pellets, shall be installed at the top of the filter pack and extend upward for a minimum of three (3) feet.
F. Neat cement grout shall be placed to within two and one-half (2.5) feet of the ground surface. The consistency of the grout shall be approved by the Engineer prior to placement.
G. Well plumbness and alignment shall be such that all wells shall be set round, plumb, and true to line.
H. The protective outer casing shall be centered on the extraction well casing and set below the depth of the frost line. The protective casing will be surrounded by concrete to a radius of at least four (4) feet. A one-quarter (0.25) inch diameter weep hole shall be drilled in the protective outer casing no more than three (3) inches above the ground surface.
I. Riser pipe shall not be greater than three (3) inches below the top of the protective casing.
J. Four (4) concrete-filled steel pipe bollards shall be placed at a distance of two (2) feet from the concrete in a square formation. Each bollard shall be set in an eighteen (18) inch concrete base. The concrete base shall extend below the depth of the frost line.
K. All metallic surfaces shall be covered with a minimum of one (1) primer coat and one (1) paint coat.

L. Soil cuttings shall be handled in accordance with Section 02111, EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

## 3.3 WELL DEVELOPMENT

A. Well development shall be in accordance with EPA 570/9-75/001 and ASTM D5092 except as modified herein. Bailing, surging, and pumping/over-pumping/backwashing are acceptable development methods. Air-surging and jetting are prohibited.

B. Well development shall not begin until the well installation is complete and accepted by the Owner and/or Engineer.

C. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials. At such time, representative water samples shall be tested for pH, temperature, and specific conductivity in accordance with EPA 600/4-79/020. When stabilized readings of these parameters have been achieved, well development operations shall cease.

D. Water from well development operations shall be as specified in Section 01562, WASTEWATER MANAGEMENT.

## 3.4 INSTALLATION SURVEY

A. Upon completion of well installation and development and acceptance by the Owner and/or Engineer, the vertical and horizontal position of each well shall be determined by a registered land surveyor licensed in the State of Illinois as specified in Section 02040, SURVEYING Paragraph 3.0.G.

## 3.5 CLEANUP

A. Upon completion of the well construction, remove debris and surplus materials from the job site.

*** END OF SECTION ***

Note: This page intentionally left blank.

## 1.0 GENERAL

### 1.1 SUMMARY

A. Provide monitoring wells including permitting, drilling, casing, well screen, filter packing, grouting, protection, development, and incidental related work complete and ready for operation.
B. Monitoring wells are to be completed as required by these Specifications and Drawings.
C. Both aboveground (stick up) or flush mount installations are specified based on well location. Refer to Drawings for determination of aboveground or flush mount installation.

### 1.2 IDENTIFICATION

A. Locations of the monitoring wells are shown on the Drawings.

### 1.3 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01550 – Equipment and Material Decontamination.
C. Section 01562 – Wastewater Management.
D. Section 02010 – Existing Utilities and Subsurface Features.
E. Section 02040 – Surveying.
F. Section 02111 – Excavation and Handling of Contaminated Material.
G. Section 02215 – Well Abandonment.
H. Section 03300 – Cast-in-Place Concrete.
I. Section 15050 – Basic Materials and Methods for Piping.
J. Drawings.

### 1.4 REFERENCE STANDARDS

A. ASTM A 312/A 312M (1995a) Seamless and Welded Austenitic Stainless Steel Pipes
B. ASTM C 136 (1996; Rev. A), Sieve Analysis of Fine and Coarse Aggregates.
C. ASTM C 150 (2002; Rev A), Portland Cement.
D. ASTM D 4750 *(1987, R1993), Determining Subsurface Liquid Levels in a* Borehole or Monitoring Well (Observation Well).
E. ASTM D 5092 (1990; Rev. 1995), Design and Installation of Ground Water Monitoring Wells in Aquifers.
F. ASTM D 5521 (1994), Development of Ground-Water Monitoring Wells in Granular Aquifers.
G. EPA 600/4-89/034 (1990), Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells.
H. EPA 570/9-75/001 (1975), Manual of Water Well Construction Practices.

## 1.5 SUBMITTALS

A. Material certificates, if applicable, for all construction materials, including casing, screen, sand, bentonite, and grout.
B. Copies of all permits, licenses, or other requirements necessary for execution of the work.
C. Borehole Logs. At a minimum, the logs should include the project name and location, well/boring designation, depth, description of all formations encountered (logged by the Driller from drill cuttings), and depth at which groundwater is encountered (as measured through the auger).
D. Installation Diagram. At a minimum, the diagram should include the project name and location, well designation, date and time of well installation, water level, construction materials, depth to screen, depth to top of filter pack, and depth to top of bentonite seal.
E. Well Development Records. Documentation should include: project name and location; well designation; date and time of well installation; date and time of well development; static water level from top of well casing before development and twenty-four (24) hours after development; field measurements of pH, temperature, and specific conductivity; depth of well from top of casing to bottom of well; screen length; description of development methodology; size/capacity of pump or bailer; pumping rate; and recharge rate.

# 2.0 PRODUCTS

## 2.1 GENERAL

A. Product material, size, and dimensions shall be as specified herein. Pipe sizes shall be commercial pipe sizes and are nominal dimension.
B. No bonding materials or lubricants shall be used on any casing or screen.
C. All equipment and materials shall be decontaminated prior to and following use as specified in Section 01550, EQUIPMENT AND MATERIAL DECONTAMINATION.

## 2.2 DELIVERY, STORAGE, AND HANDLING

A. Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation.
B. Store materials in on-site enclosures or under protective coverings. Store plastic piping under cover, out of direct sunlight. Store materials off the ground.
C. Keep insides of pipes and fittings free of dirt and debris.
D. Replace defective or damaged materials with new materials.

## 2.3 WELL CASING

A. Monitoring well casing shall consist of two (2) inch inside diameter (ID), Type 304 stainless steel, the minimum wall thickness shall be schedule 5S meeting the requirements of ASTM A 312/A 312M, with flush threaded joint fittings.

B. A threaded stainless steel cap that fits onto the top of the well casing shall be provided.

## 2.4 WELL SCREEN

A. Monitoring well screens shall consist of two (2) inch ID, type 304 stainless steel, continuous slot, wire-wound design, and threaded flush joints.

B. Monitoring well screens shall be the length shown on Drawings with a Number 10 (0.010 inch) slot size.

## 2.5 CENTRALIZERS

A. Centralizers shall be attached to the well casing when monitoring wells are over twenty (20) feet in length.

B. Centralizers will not be required if the monitoring wells are installed through hollow-stem augers.

## 2.6 FILTER PACK

A. The filter pack shall consist of washed, sieved silica sand and shall be properly sized and graded for the surrounding soil and screen slot size, and shall be composed of round, waterworn sand, free of flat or elongated pieces, organic matter, or other foreign matter.

## 2.7 BENTONITE SEAL

A. Bentonite used shall be VolClay one-quarter (0.25) inch pellets or equivalent.

## 2.8 CEMENT GROUT

A. Cement grout shall consist of a mixture of Portland Cement Type I (ASTM C 150) and water in the proportion of not more than seven (7) gallons of approved water per bag (94 lbs.) of cement. Cement grout shall contain bentonite in the proportion of three percent (3%) by weight powdered (not pellets) bentonite to cement.

## 2.9 CONCRETE

A. As specified in section 03300, CAST-IN-PLACE CONCRETE. No reinforcement shall be used and batch strength shall be three thousand (3000) psi.

## 2.10 BOTTOM PLUGS

A. Provide flush threaded solid plug at the bottom of the well. Plug shall be the same material as the well screen to which it is attached.

## 2.11 ABOVEGROUND COMPLETIONS

A. Provide protective outer casing a minimum of four (4) inches larger than the well casing diameter. A locking well cap shall be provided on top of the protective outer casing.
B. Provide three (3) steel pipe bollards having a minimum diameter of six (6) inches and a length of eight (8) feet for each well installed.

## 2.12 FLUSH MOUNT COMPLETIONS

A. Provide protective, locking, flush covers a minimum of four (4) inches larger than the well casing diameter.

# 3.0 EXECUTION

## 3.1 GENERAL

A. Contractor is responsible for obtaining well construction permits.
B. Refer to Section 02010, EXISTING UTILITIES AND SUBSURFACE FEATURES for identifying all existing subsurface utilities and site features.
C. Well locations shall be laid out according to Section 02040, SURVEYING.
D. Wells that are not completed or that are not accepted shall be abandoned in accordance with Section 02215, WELL ABANDONMENT.

## 3.2 NEW WELL INSTALLATION

A. Well installation shall be in accordance with ASTM D 5092 and EPA 570/9-75/001, and as indicated herein. Borehole shall be stable and shall be verified straight before beginning installation.
B. Wells shall be drilled using a truck-mounted drill rig equipped with an four and one-quarter (4.25) inch ID hollow-stem auger. Borings shall be advanced to a depth as shown on the Drawings.
C. Well screen placement shall be according to the depth listed on the Drawings. Groundwater elevations at each location shall be determined by the Contractor according to ASTM D 4750.
D. When the well casing has been set at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be plugged during filter pack placement.
E. Centralizers shall be spaced one hundred twenty (120) degrees apart at intervals not exceeding twenty (20) feet along the length of the casing. Centralizers shall not be placed on the screened interval or within the Bentonite seal.

F. The alignment of the well shall be verified by passing a five (5) foot long section of rigid pipe one-quarter (1/4) inch smaller OD than the ID of the casing through the entire well. If the pipe does not pass freely, then the well will not be accepted. The section of pipe shall be decontaminated prior to each test according to Section 01550, EQUIPMENT AND MATERIAL DECONTAMINATION.

G. The filter pack shall be placed in the annulus between the augers and the well casing, and the augers shall be withdrawn as the filter pack is installed to ensure positive placement of the material. The filter pack shall be installed to extend above the screen a distance of two (2) feet. All backfilling should be done in two (2) foot or smaller increments as the augers are withdrawn to keep the borehole from collapsing around the well screen before the filter pack is complete.

H. Bentonite seal, consisting of bentonite pellets, shall be installed at the top of the filter pack and extend upward for a minimum of three (3) feet.

I. Neat cement grout shall be placed to within two and one-half (2.5) feet of the ground surface. The consistency of the grout shall be approved by the Engineer prior to placement.

J. Well plumbness and alignment shall be such that all wells shall be set round, plumb, and true to line.

K. For aboveground completions, the protective outer casing shall be centered on the monitoring well casing and set below the depth of the frost line. The protective casing shall be surrounded by concrete to a radius of at least two (2) feet. A one-quarter (0.25) inch diameter weep hole shall be drilled in the protective outer casing a maximum of three (3) inches above the ground surface.

L. For flush mount completions, the protective cover shall be centered on the monitoring well casing. The protective cover shall be surrounded by concrete to a radius of at least two (2) feet.

M. Riser pipe shall not be greater than three (3) inches below the top of the protective casing or cover.

N. For aboveground completions, three (3) concrete-filled steel pipe bollards shall be placed at a distance of two (2) feet from the well in a triangular formation. Each bollard shall be set in an eighteen (18) inch concrete base. The concrete base shall extend below the depth of the frost line.

O. All metallic surfaces shall be covered with a minimum of one (1) primer coat and one (1) paint coat.

P. Soil cuttings shall be handled in accordance with Section 02111, EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

## 3.3 WELL DEVELOPMENT

A. Well development shall be in accordance with EPA 570/9-75/001 and ASTM D5092 except as modified herein. Bailing, surging, and pumping/over-pumping/ backwashing are acceptable development methods. Air-surging and jetting are prohibited.

B. Well development shall not begin until the well installation is complete and accepted by the Owner and/or Engineer.

C. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials. At such time, representative water samples shall be tested for pH, temperature, and specific conductivity in accordance with EPA 600/4-79/020. When stabilized readings of these parameters have been achieved, well development operations shall cease.

D. Water from well development operations shall be as specified in Section 01562, WASTEWATER MANAGEMENT.

## 3.4 INSTALLATION SURVEY

A. Upon completion of well installation and development and acceptance by the Owner and/or Engineer, the vertical and horizontal position of each well shall be determined by a registered land surveyor licensed in the State of Illinois as specified in Section 02040, SURVEYING Paragraph 3.0.G.

## 3.5 CLEANUP

A. Upon completion of the well construction, remove debris and surplus materials from the job site.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers requirements for repairing existing monitoring wells.
B. Existing monitoring wells that have been damaged shall be restored to working condition; wells damaged beyond repair shall be abandoned according to Section 02215, WELL ABANDONMENT.

### 1.2 RELATED SECTIONS

A. Section 01330 – Contractor Submittals.
B. Section 01550 – Equipment and Material Decontamination.
C. Section 01580 – Existing Utilities and Subsurface Features.
D. Section 02040 – Surveying.
E. Section 02215 – Well Abandonment.
F. Section 02615 – Monitoring Well Construction.
G. Section 03300 – Cast-in-Place Concrete.

### 1.3 REFERENCES

A. ASTM D 5092 (1990; Rev. 1995), Design and Installation of Ground Water Monitoring Wells in Aquifers.
B. EPA 570/9-75/001 (1975), Manual of Water Well Construction Practices
C. EPA 600/4-89/034 (1990), Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells.

### 1.4 SUBMITTALS

A. The Contractor shall submit all required items under provisions of Section 01330, CONTRACTOR SUBMITTALS and as described herein.
B. Within two (2) weeks following survey of the new and modified wells, the Contractor shall submit survey data for all wells per Section 02040, SURVEYING.

## 2.0 PRODUCTS

### 2.1 MATERIALS

A. No bonding materials or lubricants shall be used on any casing or screen.
B. All well materials are to be thoroughly cleaned before use in accordance with Section 01550, EQUIPMENT AND MATERIAL DECONTAMINATION.
C. Concrete shall be as specified in section 03300, CAST-IN-PLACE CONCRETE. No reinforcement shall be used and batch strength shall be three thousand (3,000) psi.
D. Protection shall be as specified in Section 02615, MONITORING WELL CONSTRUCTION.

## 3.0 EXECUTION

### 3.1 GENERAL

A. Refer to Table 02620-1 for monitoring wells that have been reported as damaged and require repairs.

B. Additional wells that are found damaged shall be reported to the Engineer before repairs are attempted. Wells shall not be modified without prior approval by the Engineer.

C. Existing wells shall be protected to the fullest extent possible and in accordance with Section 01580, EXISTING UTILITIES AND SUBSURFACE FEATURES.

### 3.2 WELL MODIFICATION

A. Procedures shall be in accordance with ASTM D 5092 and EPA 570/9-75/001, and as indicated herein.

B. Materials used in well repairs shall conform to those specified in Section 02615, MONITORING WELL CONSTRUCTION, except when matching or reuse of existing materials is possible.

C. Install new concrete pad around monitoring wells in accordance with Section 02615, MONITORING WELL CONSTRUCTION.

D. Install bollards around all new and previously existing wells in accordance with Section 02615, MONITORING WELL CONSTRUCTION. Where possible, existing bollards shall be re-used following outer concrete removal and approval by the Engineer.

### 3.3 INSTALLATION SURVEY

A. Upon completion of well repairs and acceptance by the Agency and/or Engineer, the vertical and horizontal position of each well shall be determined by a registered land surveyor licensed in the State of Illinois as specified in Section 02040, SURVEYING.

### 3.4 CLEANUP

A. Upon completion of well repairs, remove debris and surplus materials from the job site.

**Table 02620-1**
**Monitoring Well Repairs**
**Beloit Corporation Site, Rockton, Illinois**

| Well ID | Well Depth (TOIC) | DTW (TOIC) | Required Repair |
|---|---|---|---|
| W26C | 79.15 | 34.78 | Repair loose coupling located approximately 1.5 feet below TOC. |
| W2 | | | Repair bent well casing and re-set protective cover. |
| W13 | | | Repair bent well casing and re-set protective cover.. |
| W28 | 31.61 | 22.70 | Replace missing manhole cover, remove gravel from annular space, and repair cement pad. |
| W15 | 33.55 (top of protective cover) | 24.15 (top of protective cover) | Repair bent well casing and re-set protective cover. |
| W1R | 27.73 | 20.56 | Repair cement pad. |
| G107 | 50.84 | 41.89 | Replace well cap. |
| G101 | Root obstruction in well 42 feet from TOIC. | 41.84 | Remove well obstruction and redevelop. Install protective casing. |
| G108D | 70.60 | 35.95 | Replace well cap. |
| G108S | 42.73 | 36.52 | Straighten protective cover. |
| W44C | 56.45 | 21.93 | Repair broken lid on protective cover and clear debris from annular space. |
| W18 | 78.43 | 25.55 | Repair loose casing. |
| G103D | 49.45 | 24.01 | Repair bent well casing and re-set protective cover. |
| W37 | 38.24 | 28.85 | Replace broken lid on protective cover. |
| P1 | 20.11 | 9.89 | Extend casing and provide protective cover. |
| G109 | Obstruction | Obstruction | Remove well obstruction and redevelop. |
| W23B | 49.60 | 25.98 | Repair broken lid on protective cover and clear debris from annular space. |
| W31C | | | Repair broken lid on protective cover. |
| W35C | 69.30 | 25.79 | Repair broken lid on protective cover and clear debris from annular space. |
| W24 | Wet mass of roots and vegetation at 25.90 feet below TOIC | 25.90 | Remove well obstruction and redevelop. |
| W49C | | | Repair broken lid on protective cover. |

Key:
TOC = top of casing.
TOIC = top of inner casing.
DTW = depth to water.

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# 1. GENERAL

## 1.1 SCOPE

This section includes the requirements for pneumatic fracturing of open-hole borings designed to enhance permeability of formations. A State of Illinois licensed driller as required by state and local agencies shall perform all boring activities. It is anticipated that the Contractor will subcontract the actual fracturing work to another contractor.

## 1.2 SUBMITTALS

A. Provide scope of work for fracturing and monitoring methods to be utilized.

B. Provide documentation of any and all licenses required to perform work related to US Patent #5,032,042 (pneumatic fracturing).

C. Provide documentation of a minimum of five projects of equal dollar amount, geology, and scope that the have been completed using pneumatic fracturing. Two of the referenced projects shall have been completed in Illinois. Include scope, client references, and dollar amount.

D. Provide evidence of insurance levels, including $5,000,000 of general liability and demonstrate a current Experience Modification Factor of less than 1.

E. Provide key employee resumes and years of experience.

## 1.3 RELATED WORK

As specified in Divisions 2 through 16, inclusive.

# 2. PRODUCTS

None.

# 3. EXECUTION

## 3.1 FIELD PREPARATION

A. The drilling subcontractor will install the fracturing boreholes by auguring a 4 1/4-inch diameter borehole. Ensure that flights remain straight, boreholes greater than 6 inches in diameter will be abandoned, relocated, and re-drilled. Abandonment, re-drilling, and all other work associated with relocation will be performed at the Contractor's expense.

## 3.2 PNEUMATIC FRACTURING

A. Each new groundwater extraction well shall be pneumatically fractured prior to well construction. The locations, and depths of fractures are indicated on the Drawings.

B. Equipment used will be capable at a minimum of supplying air and/or nitrogen at 95 psi for a duration of 20 seconds across discrete 2.5 to 3 foot intervals.

C. Once the initial fracturing is completed, the bore hole will be enlarged to its final diameter as indicated on the drawings and in the specifications. Once enlarge, the open boring shall be pressurized. Equipment used will be capable at a minimum of supplying air and/or nitrogen at 95 psi for a duration of 20 seconds across the entire borehole column.

## 3.3 MONITORING REQUIREMENTS

A. General:
   1. Provide and set up all necessary equipment to monitor and record test data during fracturing.

B. Down-hole Injection Pressure:
   1. For each fracture treatment, operate a pressure transducer and data logging equipment to record pressure data at frequent intervals (every 0.5 seconds or less).

C. Ground Surface Heave:
   1. For each fracture treatment, measure ground surface heave during each fracture using surveying transits, heave rods, and/or inclinometers.
   2. Use two methods for measuring ground heave, one utilized primarily as verification.

## 3.4 REPORTING REQUIREMENTS

A. Prepare a report documenting all field activities incorporating results and conclusions.
   1. Provide the resulting pressure-time data plot and interpretation/ determination of fracture initiation pressure and fracture maintenance pressure for each fracture location.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section covers activities necessary to demobilize and close out the contract. Work activities shall include the following:
   1. Removal of all Contractor equipment and materials from site.
   2. Collection and disposal of all Contractor-generated waste materials.
   3. Disconnection and removal of temporary utilities from site as specified in Section 01520, TEMPORARY UTILITIES.
   4. Removal of field office structure as specified in Section 01510, TEMPORARY CONSTRUCTION TRAILER.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01510 – Temporary Construction Trailer.
C. Section 01520 – Temporary Utilities.
D. Section 01800 – Site Maintenance.

### 1.3 SUBMITTALS

A. Project record documents shall be submitted in accordance with the requirements as specified in Section 01330, CONTRACTOR SUBMITTALS.

## 2.0 PRODUCTS

[Not used.]

## 3.0 EXECUTION

A. All temporary utilities as identified in specification Section 01520, TEMPORARY UTILITIES shall be disconnected or discontinued at such time when no longer required for site operations or until other site activities require their use. Five (5) working days' written notice prior to any disconnection of temporary utilities or termination of services shall be provided to the Engineer.
B. The field office structures(s) shall be removed from the site at such time when no longer required, with prior approval by the Engineer.
C. Any erosion, drainage, or final cover damage resulting from Contractor activities shall be repaired.
D. The Contractor shall complete final site cleaning activities as specified in Section 01800, SITE MAINTENANCE.
E. The Contractor shall submit as part of the project closeout any record documents.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.

### 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.
B. Section 01620 – Storage and Protection.
C. Drawings.

### 1.3 REFERENCE STANDARDS

A. ACI 117, Specifications for Tolerances for Concrete Construction and Materials.
B. ACI 301, Specification for Structural Concrete.
C. ACI 302.1R, Guide for Concrete Floor and Slab Construction.
D. ACI 306.1, Specification for Cold Weather Concreting.
E. ACI 308.1, Specification for Curing Concrete.
F. ACI 347, Guide to Formwork for Concrete.
G. ASTM A82, Steel Wire, Plain, for Concrete Reinforcement.
H. ASTM A185, Steel Welded Wire Reinforcement, Plain, for Concrete.
I. ASTM A615/A615M, Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
J. ASTM C31/C31M, Making and Curing Concrete Test Specimens in the Field.
K. ASTM C39/C39M, Compressive Strength of Cylindrical Concrete Specimens.
L. ASTM C33, Concrete Aggregates.
M. ASTM C42, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
N. ASTM C94/C94M, Ready-Mixed Concrete.
O. ASTM C143, Test Method for Slump of Hydraulic-Cement Concrete.
P. ASTM C150, Portland Cement.
Q. ASTM C172, Sampling Freshly Mixed Concrete.
R. ASTM C231, Test Method of Air Content of Freshly Mixed Concrete by the Pressure Method.
S. ASTM C260, Air-Entraining Admixtures for Concrete.
T. ASTM C309, Liquid Membrane-Forming Compounds for Curing Concrete.
U. ASTM C494A, Chemical Admixtures for Concrete.
V. ASTM C1064, Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

W. ASTM C1077, Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
X. ASTM D 1751, preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
Y. ASTM E329, Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
Z. ASTM E1155, Determining Floor Flatness and Floor Levelness Numbers.

## 1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Design Mixtures: Submit design mixture of concrete mix proposed for use that meets the requirements of this specification section.
C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
D. Qualification Data: For testing agency.
E. Material Test Reports: For the following, from an approved batch plant indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
F. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.
   4. Floor and slab treatments.
   5. Semirigid joint filler.
   6. Joint-filler strips.
G. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher, or a supervisor who is an ACI-certified Concrete Flatwork Technician, or Project personnel who through experience are capable of completing Project requirements as specified and required.
B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, Specification for Structural Concrete.
  2. ACI 117, Specifications for Tolerances for Concrete Construction and Materials.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

## 2.0 PRODUCTS

## 2.1 FORM FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, with widths as shown on the drawings.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  1. Furnish ties that, when removed, will leave holes no larger than one (1) inch in diameter in concrete surface.

## 2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

C. Plain-Steel Wire: ASTM A 82, as drawn.

## 2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufactured bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

## 2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II, gray.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least ten (10) years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Slag shall not be used.
   1. Maximum Coarse-Aggregate Size: one (1) inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

## 2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494, Type A.

## 2.6 WATERSTOP

A. Flexible PVC Waterstops: for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Ribbed with center bulb.
   2. Dimensions: Six (6) inches by three-eighths (3/8) inch thick.

## 2.7 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than fifty (50) percent aluminum oxide and not less than twenty (20) percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with one hundred (100) percent passing No. 4 sieve.

## 2.8 CURING MATERIALS

A. Clear, Waterborne, Membrane-Forming Curing Compound with maximum VOC emissions of three hundred fifty (350) g/L: ASTM C 309, Type 1, Class B, dissipating.

## 2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

## 2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

## 2.11 CONCRETE MIXTURES

A. Minimum Compressive Strength: Four thousand (4,000) psi at twenty-eight (28) days.

B. Maximum Water-Cementitious Materials Ratio: Four-tenths (0.40).

C. Slump Limit: Four (4) inches plus or minus one (1) inch.

D. Air Content: Four (4) percent, plus or minus one and one-half (1.5) percent at point of delivery.

## 2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
   1. When air temperature is between eighty-five and ninety (85 and 90) deg F reduce mixing and delivery time from one and one-half (1-1/2) hours to seventy-five (75) minutes; when air temperature is above ninety (90) deg F,

reduce mixing and delivery time to sixty (60) minutes.

## 3.0. EXECUTION

### 3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual.
D. Construct forms tight enough to prevent loss of concrete mortar.
E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than one and one-half (1.5) horizontal to one (1) vertical.
   1. Install keyways, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.
F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
G. Chamfer exterior corners and edges of permanently exposed concrete.
H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
B. Install pipe penetration steel sleeves within forms for vertical walls and secure in such a manner as to prevent seepage of mortar, water or other liquids into the pipe

sleeves.

C. Install pipe penetration steel sleeves in slab pours prior to placement of concrete and around pipe installed previously and secure against movement to maintain an even annular space around the pipe.

## 3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than fifty (50) deg F for twenty-four (24) hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

## 3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" latest edition for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Lap lengths of splices shall be to the length shown on the drawings. If lap lengths are not shown on the drawings, comply with CRSI standards.

## 3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least one and one-half (1-1/2) inches into concrete.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of one-eighth (1/8) inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half (1/2) of dowel length to prevent concrete bonding to one (1) side of joint.

## 3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least six (6) inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below fifty (50) deg F, maintain delivered concrete mixture temperature at a minimum of fifty (50) deg F for three (3) successive days.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below ninety (90) deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## 3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.

## 3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to horizontal surfaces.

C. Trowel Finish: After applying float finish, apply first troweling and continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to horizontal surfaces.
2. Finish surfaces and measure surface so gap at any point between concrete surface and an unleveled, freestanding, ten (10)-foot- long straightedge resting on two (2) high spots and placed anywhere on the surface does not exceed one-quarter (1/4) inch.

D. Slip-Resistive Finish: Before final floating, apply slip-resistive approved crushed emery aggregate on the slab, stair platforms, and ramps. Do not apply to equipment pads.

## 3.9 MISCELLANEOUS CONCRETE ITEMS

A. Curbs: Provide monolithic finish to curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

## 3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
D. Cure concrete according to ACI 308.1, by one or a combination of the following methods unless the manufacturer of the slip-resistive approved crushed emery aggregate states in writing that the curing method should not be completed due to the effectiveness or adhesion of the slip-resistive approved crushed emery aggregate. In that case, the contractor shall propose a:
   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Repeat process twenty-four (24) hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

## 3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least two (2) inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

## 3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one (1) part portland cement to two and one-half (2-1/2) parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than one-half (1/2) inch in any dimension in solid concrete, but not less than one (1) inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of one-one-hundreth (0.01) inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least fourteen (14) days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching

mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of one-quarter (1/4) inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes one (1) inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a three-quarter (3/4)-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least seventy-two (72) hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

## 3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding five (5) cy, but less than twenty-five (25) cy, plus one (1) set for each additional fifty (50) cy or fraction thereof.
2. Slump: ASTM C 143; one (1) test at point of placement for each truck load received prior to placement of truck's load, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one (1) test at point of placement for each truck load received prior to placement of truck's load, but not less than one (1) test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064 one (1) test hourly when air temperature is forty (40) degree F and below and when eighty (80) degree F and above, and one (1) test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two (2) sets of two (2) standard cylinder

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# B

# Mass Balance Calculations for Expansion of Existing Ground-water Extraction and Treatment System

ecology & environment engineering, inc.
International Specialists in the Environment

# TECHNICAL MEMORANDUM

Date: April 13, 2007

To: Project File

Prepared by: Neil J. Brown, P.E.

Checked By: Tom Campbell, P.E.

Subject: Mass Balance Calculations for Expansion of Existing Groundwater Extraction and Treatment System – Former Beloit Corporation (Blackhawk Facility) Rockton, Illinois

The purpose of this Technical Memorandum (TM) is to present the calculations and data associated with the justification that the existing groundwater treatment plant at the above-referenced site is capable of meeting its National Pollutant Discharge Elimination System (NPDES) permit requirements once three new groundwater extraction wells are constructed and placed into service. Additionally, air discharge calculations associated with an increase in atmospheric loadings were also performed.

## Background

The former Beloit Corporation's Blackhawk facility (the site) is located in Rockton Township, in north-central Illinois. This National Priorities List (NPL) site occupies part of the northern half of Section 13 and the southwest quadrant of Section 12, T46N, R1E, Winnebago County, Illinois.

The final Record of Decision (ROD) for the site was signed in September 2004. The selected remedial action contained in the ROD is a final, sitewide remedy that addresses the groundwater contamination at the site. The ROD specifies that the primary remedy for the site is the existing pump-and-treat system, which is to be augmented by chemical oxidation of groundwater and soil in the Erection Bay source area, and the installation of additional extraction wells, as necessary.

Based on the findings of a Source Area Investigation (SAI) performed by Ecology and Environment, Inc. (E & E), it was determined that the source area is approximately five times larger than the source area delineated in the Remedial Investigation and evaluated in the Feasibility Study report. (The SAI defined *source areas* as areas where groundwater total volatile organic compound (VOC) concentrations are approximately 500 micrograms per liter [μg/L] or more.)

Based on the findings of the SAI, the Illinois Environmental Protection Agency (Illinois EPA) subsequently tasked Ecology and Environment Engineering, Inc. (EEEI) to develop plans and specifications for expanding the existing pump-and-treat system by installing three new groundwater extraction wells.

## Mass Balance Calculations

The current pump-and-treat system relies on an air stripper to remove VOCs from the aqueous influent stream. The stripped VOCs are subsequently discharged to the atmosphere. The air stripper is rated to handle an influent stream of 400 gallons per minute (gpm). Currently, groundwater is extracted and processed through the system at a rate of 170 gpm. In theory, the existing system has the capacity for expansion.

In order to determine whether the existing pump-and-treat system has the capacity to effectively remove the additional loading associated with the three new extraction wells, mass balance calculations were performed. The NPDES permit (Permit #IL0064564) for the site has established 30-day average and maximum daily discharge criteria for the following chlorinated VOCs:

- 1,1,1–Trichloroethane (22 μg/L monthly average, and 59 μg/L daily maximum);
- 1,1-Dichloroethene (22 μg/L monthly average, and 59 μg/L daily maximum);
- 1,2–Dichloroethane (180 μg/L monthly average, and 574 μg/L daily maximum);
- Tetrachloroethene (52 μg/L monthly average, and 164 μg/L daily maximum);
- Trichloroethene (26 μg/L monthly average, and 69 μg/L daily maximum);
- 1,1-Dichloroethene (22 μg/L monthly average, and 59 μg/L daily maximum); and
- Total 1,2–Dichloroethene (25 μg/L monthly average, and 66 μg/L daily maximum).

For total 1,2-dichloroethene, the analytical results provided to EEEI present data as cis-1,2-dichloroethene and trans-1,2-dichloroethene. Mass balance calculations have been performed for both the cis and trans fractions, and these individual totals were then added together to obtain the value for total 1,2-dichloroethene.

Once the contaminants have been selected, it is necessary to determine the removal efficiency of the existing system with regard to each contaminant. Influent and effluent data for the treatment system was used (influent and effluent data is presented as Attachments 1 and 2, Tables B1 and B2). It should be noted that concentrations for much of the influent and effluent data were reported as not detected, and the detection limit was stated (e.g., < 5 μg/L). In these instances and to be conservative, a value of one-half the detection limit was used in the calculations. Where one-half the detection limit was used, the concentrations are italicized in Tables B1 and B2. Additionally, there were a total of only six influent samples (EWC-extraction wells) collected and analyzed over the course of three years of operation.

Using the data from 2004, 2005, and 2006, the yearly average, maximum, and minimum concentrations for each contaminant were determined (see Tables 1 and 2). Using the average influent and effluent concentrations for a contaminant, the pump-and-treat removal efficiency was calculated using the following equation:

Removal Efficiency = 100 x $(C_{inf} - C_{eff})/C_{inf}$ Where: $C_{inf}$ = Influent Concentration
$C_{eff}$ = Effluent Concentration

This calculation was performed on a yearly basis for each contaminant. A summary of the results is presented in Table 3. While flow is a major component of this calculation, it was not incorporated in this set of calculations. Based on operational data for the treatment system, influent and effluent flow rates were consistently reported at 170 gpm. Given this steady-state condition, flow data was not needed.

It should be noted that for 1,1-dichloroethane, 1,2-dichloroethane, and trans-1,2-dichloroethene, analytical results for all influent and effluent samples were non-detect. If removal efficiencies were to be calculated for these compounds, the value would be based solely on method detection limits. Therefore, their removal efficiencies were not calculated. Additionally, the data for 2006 did not indicate cis-1,2-dichloroethene, 1,1,1-trichloroethene, or 1,1-dichloroethene in the either the influent or effluent, so no removal efficiencies were calculated. Similarly, a removal efficiency for 1,1-dichloroethene was not calculated for 2004.

In order to determine whether the existing treatment system has sufficient capacity, it is necessary to determine the increase in flow and the contaminant concentration associated with it. As part of the 30% remedial design effort, EEEI used FLOWPATH II (Version 1.1), developed by Waterloo Hydrogeologic Inc., to model the source area. Based on the model results, it was determined that three additional groundwater extraction wells (EW05, EW06, and EW07) are needed to address source area contamination. Target pumping rates for the additional extraction wells are as follows:

- EW05 – 16 gpm;
- EW06 – 15 gpm; and
- EW07 – 15 gpm.

Using data from the SAI, the contaminant concentration for each new extraction well was estimated. Table 4 provides a summary of the influent concentrations for each new extraction well, as well as the sampling location source that was used to predict the influent concentration.

Once the existing removal efficiencies, and new influent flow and associated contaminant concentrations, were developed, mass balance calculations were performed.

The mass balance calculations include a series of individual calculations in which the mass of an individual contaminant for an individual stream is determined. By summing the individual mass values and the total flow (existing flow plus new flow), a total mass load as well as a new influent concentration is determined. The new resulting effluent concentration is calculated as follows:

$C_{eff}$ = 1 – (Removal Efficiency x $C_{inf}$) Where: $C_{inf}$ = Influent Concentration
$C_{eff}$ = Effluent Concentration

Two sets of mass balance calculations for each contaminant were performed. Given that the initial mass loading (i.e., the current system operation) varies, this variation can cause changes in the effluent concentration. Therefore, in order to be conservative, for the first set of calculations, the maximum detected influent contaminant concentration and the lowest calculated yearly removal efficiency were used. The second set of calculations used the average influent concentration for the contaminants and the lowest calculated removal efficiency.

For those contaminants (1,1-dichloroethane, 1,2-dichloroethane, trans-1,2-dichloroethene) that did not have a removal efficiency determined or which had limited data (1,1-dichloroethene and cis-1,2-dichoroethene), the average VOC removal efficiency was used.

Table 5 provides a summary of the individual influent and effluent calculations. The NPDES permit limits are also provided in the table. Attachment 3 provides the mass balance calculations (maximum and average) for each individual contaminant.

The results show that the existing pump-and-treat system has the capacity to accept the increase in flow and contaminant loading associated with the installation of the three new groundwater extraction wells.

In addition to performing mass balance calculations associated with aqueous effluent discharge, potential air discharge calculations were also performed. In developing a worst-case scenario, it was assumed that all of the contaminants would be stripped from the influent and discharged to the atmosphere. Under this assumption, it was determined that approximately 544 pounds (i.e., 0.272 tons) of VOCs would be discharged on a yearly basis.

## Conclusion

Based on the mass balance calculations performed, the existing pump-and-treat system at the Beloit site has the capacity to accept an increase in flow of approximately 46 gpm, as well as to continue meeting the existing NPDES permit limits associated with chlorinated VOCs, provided the system is properly maintained and operated.

**Table 1** **Statistical Summary of Influent (EWC) Data**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| | Chemical of Concern | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Concentration | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
| **2004 (3 Sampling Rounds)** | | | | | | | | | |
| Average | ND | ND | ND | 1.26 | ND | 10.16 | 1.51 | 2.31 | 16.08 |
| Maximum | ND | ND | ND | 2.54 | ND | 18.40 | 2.79 | 5.33 | 30.06 |
| Minimum | ND | ND | ND | 0.25 | ND | 2.20 | 0.75 | 0.59 | 4.29 |
| **2005 (2 Sampling Rounds)** | | | | | | | | | |
| Average | ND | ND | 0.70 | 0.78 | ND | 12.00 | 2.20 | 1.90 | 18.20 |
| Maximum | ND | ND | 1.00 | 1.00 | ND | 23.00 | 3.40 | 2.80 | 30.39 |
| Minimum | ND | ND | 0.39 | 0.55 | ND | 1.00 | 1.00 | 1.00 | 6.00 |
| **2006 (1 Sampling Round)** | | | | | | | | | |
| Average | ND | ND | ND | ND | ND | 130.00 | ND | 2.50 | 142.50 |
| Maximum | ND | ND | ND | ND | ND | 130.00 | ND | 2.50 | 142.50 |
| Minimum | ND | ND | ND | ND | ND | 130.00 | ND | 2.50 | 142.50 |
| **Totals for 2004 through 2006 (6 Sampling Rounds)** | | | | | | | | | |
| Average | ND | ND | 0.70 | 1.02 | ND | 50.72 | 1.86 | 2.24 | 58.92 |
| Maximum | ND | ND | 1.00 | 2.54 | ND | 130.00 | 3.40 | 5.33 | 147.50 |
| Minimum | ND | ND | 0.39 | 0.25 | ND | 1.00 | 0.75 | 0.59 | 5.30 |

*Note: All concentrations are in micrograms per liter.*

**Table 2** **Statistical Summary of Effluent Data**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| | Chemical of Concern | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Concentration | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
| **2004** | | | | | | | | | |
| Average | ND | ND | ND | 0.31 | ND | 0.90 | 0.28 | 0.22 | 2.96 |
| Maximum | ND | ND | ND | 1.00 | ND | 2.10 | 1.00 | 1.00 | 8.00 |
| Minimum | ND | ND | ND | 0.25 | ND | 0.25 | 0.10 | 0.10 | 1.85 |
| **2005** | | | | | | | | | |
| Average | ND | ND | 0.25 | 0.25 | ND | 0.68 | 0.25 | 0.10 | 2.26 |
| Maximum | ND | ND | 0.25 | 0.25 | ND | 0.96 | 0.25 | 0.10 | 2.56 |
| Minimum | ND | ND | 0.25 | 0.25 | ND | 0.25 | 0.25 | 0.10 | 1.85 |
| **2006** | | | | | | | | | |
| Average | ND | ND | ND | ND | ND | 0.76 | ND | 0.50 | 4.26 |
| Maximum | ND | ND | ND | ND | ND | 1.20 | ND | 0.50 | 4.70 |
| Minimum | ND | ND | ND | ND | ND | 0.50 | ND | 0.50 | 4.00 |
| **Totals for 2004 through 2006** | | | | | | | | | |
| Average | ND | ND | 0.25 | 0.28 | ND | 0.78 | 0.27 | 0.27 | 3.16 |
| Maximum | ND | ND | 0.25 | 1.00 | ND | 2.50 | 1.00 | 2.50 | 20.00 |
| Minimum | ND | ND | 0.25 | 0.25 | ND | 0.25 | 0.10 | 0.10 | 1.90 |

*Note: All concentrations are in micrograms per liter.*

**Table 3** **Summary of Removal Efficiencies**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| | Chemical of Concern | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
| 2004 | NC | NC | NC | 75.3% | NC | 91.1% | 81.2% | 90.6% | 81.6% |
| 2005 | NC | NC | 64.0% | 67.7% | NC | 94.3% | 88.6% | 94.7% | 87.6% |
| 2006 | NC | NC | NC | NC | NC | 99.4% | NC | 80.0% | 97.0% |
| | | | | | | | | **Three Year Average:** | **88.7%** |

**Key**

ND = Not Detected.
1,1-DCA = 1,1-Dichloroethane.
1,2-DCA = 1,2-Dichloroethane.
1,1-DCE = 1,1-Dichloroethene.
cis 1,2-DCE = cis 1,2-Dichloroethene.
trans 1,2-DCE = trans 1,2-Dichloroethene.
PCE = Tetrachloroethene.
1,1,1-TCA = 1,1,1-Trichloroethane.
TCE = Trichloroethene.
VOCs = Volatile Organic Compounds.
NC = Not Calculated.

**Table 4 Summary of Influent Concentration Data for New Extraction Wells**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| Monitoring Well | MW23B | GW07 | GW08 |
|---|---|---|---|
| **Chemical/New Extraction Well** | **EW05** | **EW06** | **EW07** |
| 1,1,1-Trichloroethane | *5* | 10 | 11 |
| 1,1-Dichloroethane | *5* | 1.6 | *1* |
| 1,2-Dichloroethane | *5* | *0.5* | *1* |
| Tetrachloroethene | 1,600 | 2300 | 880 |
| Trichloroethene | 52 | 58 | 5.2 |
| 1,1-Dichloroethene | *5* | 2 | *1* |
| cis 1,2-dichloroethene | 1200 | 270 | 8.9 |
| trans 1,2-dichloroethene | 23 | 4.6 | 0.1 |

***Note:*** *All concentrations are in micrograms per liter, and italic values are one half the method detection limit.*

**Table 5 Summary Existing and Future Influent and Effluent Concentrations**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| | Influent | | | | Effluent | | | | NPDES Limits | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Existing | | Future | | Existing | | Future | | 30-Day | Daily |
| Chemical | Average | Maximum | Average | Maximum | Average | Maximum | Average | Maximum | Average | Maximum |
| 1,1,1-Trichloroethane | 1.9 | 3.4 | 3.3 | 110.5 | 0.3 | 1.0 | 0.6 | 0.8 | 22 | 59 |
| 1,1-Dichloroethane | ND | ND | 0.6 | 0.6 | ND | ND | 0.1 | 0.1 | 22 | 59 |
| 1,2-Dichloroethane | ND | ND | 0.5 | 0.5 | ND | ND | 0.1 | 0.1 | 180 | 574 |
| Tetrachloroethene | 50.7 | 130.0 | 380.1 | 442.5 | 0.8 | 2.5 | 33.7 | 39.2 | 52 | 164 |
| Trichloroethene | 2.2 | 5.3 | 10.0 | 12.5 | 0.3 | 2.5 | 2.0 | 2.5 | 26 | 69 |
| 1,1-Dichloroethene | 0.7 | 1.0 | 1.1 | 1.4 | 0.3 | 0.3 | 0.1 | 0.2 | 22 | 60 |
| cis 1,2-dichloroethene | 1.0 | 2.5 | 109.3 | 110.5 | 0.3 | 1.0 | 12.3 | 12.5 | NE | NE |
| trans 1,2-dichloroethene | ND | ND | 2.0 | 2.0 | ND | ND | 0.2 | 0.2 | NE | NE |
| total 1,2-dichloroethene | 1.0 | 2.5 | 111.4 | 112.6 | 0.3 | 1.0 | 12.6 | 12.7 | 25 | 66 |

***Note:*** *All concentrations are in micrograms per liter.*

**KEY**

NPDES = National Discharge Permit Eliminate System.
ND = Not Detected.
NE = Not established.

**Table 6 Summary of Air Discharge (Worse Case Scenario)**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| Chemical | µg/day | lbs/day | lbs/year | tons/year |
|---|---|---|---|---|
| 1,1,1-Trichloroethane | 5,292,944 | 0.01 | 4.27 | 0.002 |
| 1,1-Dichloroethane | 648,598 | 0.00 | 0.52 | 0.000 |
| 1,2-Dichloroethane | 558,666 | 0.00 | 0.45 | 0.000 |
| Tetrachloroethene | 519,574,520 | 1.14 | 419 | 0.209 |
| Trichloroethene | 14,624,180 | 0.03 | 11.79 | 0.006 |
| 1,1-Dichloroethene | 1,604,840 | 0.00 | 1.29 | 0.001 |
| cis 1,2-dichloroethene | 129,795,220 | 0.29 | 104.64 | 0.052 |
| trans 1,2-dichloroethene | 2,390,000 | 0.01 | 1.93 | 0.001 |
| Total VOCs: | 674,488,968 | 1.49 | 544 | 0.272 |

**KEY**

µg/day = Micrograms per day.
lbs/day = Pounds per day.
lbs/year = Pounds per year.
VOCs = Volatile Organic Compounds.

# Attachment 1

# Influent Data

**Table B1** **Summary of Influent (EWC) Data**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| Sample Date | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
|---|---|---|---|---|---|---|---|---|---|
| 4/14/2004 | *1* | *1* | *1* | *1* | *1* | 9.88 | *1* | *1* | 17 |
| 10/12/2004 | *0.5* | *0.25* | *0.25* | *0.25* | *0.5* | 2.2 | *0.75* | 0.59 | 5 |
| 12/1/2004 | *1* | *1* | *1* | 2.54 | *1* | 18.4 | 2.79 | 5.33 | 33 |
| 2/24/2005 | *1* | *1* | *1* | *1* | *1* | 1 | *1* | *1* | 8 |
| 5/12/2005 | 0.69 | *0.025* | 0.39 | 0.55 | *0.25* | 23 | 3.4 | 2.8 | 31 |
| 10/7/2005 | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled |
| 5/17/2006 | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled | not sampled |
| 9/28/2006 | *2.5* | *2.5* | *2.5* | *2.5* | *2.5* | 130 | *2.5* | 2.5 | 148 |
| 1/10/2007 | *0.5* | *0.5* | *0.5* | 0.5 | *0.5* | 17 | 2 | 2 | 24 |

***Note:*** *All concentrations are in micrograms per liter, and values listed in italics were not detected, and one half the detection limit was used.*

# Attachment 2

# Effluent Data

Table B2 Summary of Effluent Data
Former Beloit Corporation -Blackhawk Facility
Rockton, Illinois

| Sample Date | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
|---|---|---|---|---|---|---|---|---|---|
| 11/5/2003 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.6 | 0.25 | 0.1 | 3.2 |
| 11/19/2003 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.3 | 0.25 | 0.1 | 2.9 |
| 12/3/2003 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.4 | 0.25 | 0.1 | 3.0 |
| 12/17/2003 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.1 | 0.25 | 0.1 | 2.7 |
| 1/7/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.2 | 0.25 | 0.1 | 2.8 |
| 1/21/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.5 | 0.25 | 0.1 | 3.1 |
| 2/6/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.67 | 0.25 | 0.1 | 2.3 |
| 2/19/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.57 | 0.25 | 0.1 | 2.2 |
| 3/3/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.62 | 0.25 | 0.1 | 2.2 |
| 3/17/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.1 | 1.9 |
| 4/14/2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8.0 |
| 4/30/2004 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8.0 |
| 5/21/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.1 | 1.9 |
| 5/29/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.6 | 0.25 | 0.1 | 2.2 |
| 6/11/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.56 | 0.25 | 0.1 | 2.2 |
| 6/24/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.77 | 0.25 | 0.1 | 2.4 |
| 7/9/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.51 | 0.25 | 0.1 | 2.1 |
| 7/21/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.64 | 0.25 | 0.23 | 2.4 |
| 8/6/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.56 | 0.25 | 0.1 | 2.2 |
| 8/20/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.52 | 0.25 | 0.1 | 2.1 |
| 9/3/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 2.1 | 0.21 | 0.25 | 3.8 |
| 9/17/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.7 | 0.22 | 0.25 | 2.4 |
| 10/1/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.5 | 0.1 | 0.25 | 3.1 |
| 10/5/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.3 | 0.1 | 0.25 | 2.9 |
| 11/2/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.3 | 0.1 | 0.25 | 2.9 |
| 11/16/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.5 | 0.1 | 0.25 | 3.1 |
| 12/7/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.1 | 0.25 | 0.1 | 2.7 |
| 12/21/2004 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.87 | 0.25 | 0.1 | 2.5 |
| 1/4/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.87 | 0.25 | 0.1 | 2.5 |
| 1/18/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.1 | 1.9 |
| 2/1/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.88 | 0.25 | 0.1 | 2.5 |
| 2/15/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.64 | 0.25 | 0.1 | 2.2 |
| 3/8/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.58 | 0.25 | 0.1 | 2.2 |
| 3/22/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.63 | 0.25 | 0.1 | 2.2 |
| 4/5/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.94 | 0.25 | 0.1 | 2.5 |
| 4/19/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.96 | 0.25 | 0.1 | 2.6 |
| 5/3/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.1 | 1.9 |
| 5/3/2005 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.1 | 1.9 |
| 5/17/2005 | 0.25 | 0.1 | 0.25 | 0.25 | 0.25 | 0.96 | 0.25 | 0.1 | 2.4 |
| 5/17/2005 | 0.25 | 0.1 | 0.25 | 0.25 | 0.25 | 0.96 | 0.25 | 0.1 | 2.4 |
| ~~9/29/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~10/5/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~10/18/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~11/22/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~11/30/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~12/7/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| ~~12/21/2005~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~2.5~~ | ~~20.0~~ |
| 1/12/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 4.5 |
| 1/26/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1.2 | 0.5 | 0.5 | 4.7 |
| 2/8/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 4.5 |
| 2/22/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 4.5 |
| 3/8/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 4.5 |
| 3/17/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 4.0 |
| 4/5/2006 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 | 0.5 | 4.5 |

Table B2 **Summary of Effluent Data**
**Former Beloit Corporation -Blackhawk Facility**
**Rockton, Illinois**

| Sample Date | 1,1-DCA | 1,2-DCA | 1,1-DCE | cis 1,2-DCE | trans 1,2-DCE | PCE | 1,1,1-TCA | TCE | Total VOCS |
|---|---|---|---|---|---|---|---|---|---|
| 4/19/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 1 | *0.5* | *0.5* | 4.5 |
| 5/10/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 1 | *0.5* | *0.5* | 4.5 |
| 5/17/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 1 | *0.5* | *0.5* | 4.5 |
| 6/7/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 6/21/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 10/4/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 10/18/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 11/1/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 11/20/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 12/6/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |
| 12/20/2006 | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | *0.5* | 4.0 |

***Note:*** *All concentrations are in micrograms per liter, data listed in italics were not detected and one half the detection limit was inserted. Finally, data with strike throughs were not used in the calculations.*

# Attachment 3

# Mass Balance Calculations

## Mass Balance Calculations for 1,1, 1- Trichloroethane (Average Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Average Detected Influent Concentration: | 1.86 μg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 1,714,706 μg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 1.7 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 81.2% | From Table 3 |
| 6 | Loading to River: | 0.3 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 1.4 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 μg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 μg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 10 μg/L | From Table 4 |
| 15 | Mass Loading: | 817,560 μg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 11 μg/L | From Table 4 |
| 19 | Mass Loading: | 899,316 μg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 2152908 μg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 3,867,614 μg or | Line 3 + Line 21 |
| 24 | | 3.9 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 3.3 μg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 81.2% | From Table 3 |
| 27 | Loading to River: | 0.7 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.6 μg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 3.1 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for trans 1,2 -Dichloroethene (Average Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | | Source |
|---|---|---|---|---|
| 1 | Average Detected Influent Concentration: | ND | µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 | gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 0 | µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.0 | grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | NC | | From Table 3 |
| 6 | Loading to River: | 0.0 | grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.0 | grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | | |
| | ***MW23B*** | | | |
| 8 | Design Extraction Rate: | 16 | gpm or | Design Criteria |
| 9 | | 23,040 | gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 23 | µg/L | From Table 4 |
| 11 | Mass Loading: | 2,005,747 | µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | | |
| 12 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 13 | | 21,600 | gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 4.6 | µg/L | From Table 4 |
| 15 | Mass Loading: | 376,078 | µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | | |
| 16 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 17 | | 21,600 | gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 0.1 | µg/L | From Table 4 |
| 19 | Mass Loading: | 8,176 | µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | | |
| 20 | Overall Extraction Rate: | 66,240 | gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 2390000 | µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | | |
| 22 | Influent Flow Rate: | 310,240 | gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 2,390,000 | µg or | Line 3 + Line 21 |
| 24 | | 2.4 | grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 2.0 | µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.3 | grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.2 | µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 2.1 | grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for Tetrachloroethene (Average Influent Concentration)

**Basis: 24-hours**

| Line | ***Baseline Mass Loading*** | | **Source** |
|---|---|---|---|
| 1 | Average Detected Influent Concentration: | 50.72 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 46,841,949 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 46.8 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 91.1% | From Table 3 |
| 6 | Loading to River: | 4.1 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 42.7 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 1,600 µg/L | From Table 4 |
| 11 | Mass Loading: | 139,530,240 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 2,300 µg/L | From Table 4 |
| 15 | Mass Loading: | 188,038,800 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 880 µg/L | From Table 4 |
| 19 | Mass Loading: | 71,945,280 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 399,514,320 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 446,356,269 µg or | Line 3 + Line 21 |
| 24 | | 446.4 grams | Line 23 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 380.1 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 91.1% | From Table 3 |
| 27 | Loading to River: | 39.5 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 33.7 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 406.8 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for cis 1,2-Dichloroethene (Average Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Average Detected Influent Concentration: | 1.02 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 941,241 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.9 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 6 | Loading to River: | 0.1 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.8 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 1200 µg/L | From Table 4 |
| 11 | Mass Loading: | 104,647,680 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 270 µg/L | From Table 4 |
| 15 | Mass Loading: | 22,074,120 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 8.9 µg/L | From Table 4 |
| 19 | Mass Loading: | 727,628 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 127449428 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 128,390,670 µg or | Line 3 + Line 21 |
| 24 | | 128.4 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 109.3 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 14.5 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 12.3 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 113.9 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,2-Dichloroethane (Average Influent Concentration)

Mas

**Basis: 24-hours**

Basis

| Line | *Baseline Mass Loading* | | Source | Line |
|---|---|---|---|---|
| 1 | Average Detected Influent Concentration: | ND µg/L | From Table 1 | 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports | 2 |
| 3 | Mass Loading: | 0 µg or | Line 1 x Line 2 x 3.785 liters per gallon | 3 |
| 4 | | 0.0 grams | Line 3 / 1,000,000 micrograms per gram | 4 |
| 5 | Removal Efficiency: | NC | From Table 3 | 5 |
| 6 | Loading to River: | 0.0 grams per day | (1 - Line 5) x Line 4 | 6 |
| 7 | Discharge to Air: | 0.0 grams per day | Line 4 - Line 6 | 7 |
| | ***Mass Loading Associated With New Wells*** | | | |
| | ***MW23B*** | | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria | 8 |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day | 9 |
| 10 | Influent Concentration: | 5 µg/L | From Table 4 | 10 |
| 11 | Mass Loading: | 436,032 µg | Line 9 x Line 10 x 3.785 liters/gallon | 11 |
| | ***GW07*** | | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria | 12 |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day | 13 |
| 14 | Influent Concentration: | 0.5 µg/L | From Table 4 | 14 |
| 15 | Mass Loading: | 40,878 µg | Line 13 x Line 14 x 3.785 liters/gallon | 15 |
| | ***GW08*** | | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria | 16 |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day | 17 |
| 18 | Influent Concentration: | 1 µg/L | From Table 4 | 18 |
| 19 | Mass Loading: | 81,756 µg | Line 17 x Line 18 x 3.785 liters/gallon | 19 |
| | Combined (EW05, EW06 & EW07) | | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 | 20 |
| 21 | Mass Loading: | 558666 µg | Line 11 + Line 15 + Line 19 | 21 |
| | **Overall System With New Wells** | | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 | 22 |
| 23 | Influent Mass Loading: | 558,666 µg or | Line 3 + Line 21 | 23 |
| 24 | | 0.6 grams | Line 24 / 1,000,000 micrograms per gram | 24 |
| 25 | Influent Concentration: | 0.5 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) | 25 |
| 26 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) | 26 |
| 27 | Loading to River: | 0.1 grams per day | Line 24 x (1 - Line 26) | 27 |
| 28 | Effluent Concentration: | 0.1 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) | 28 |
| 29 | Discharge to Air: | 0.5 grams per day | Line 24 - Line 27 | 29 |

## Mass Balance Calculations for 1,1-Dichloroethene (Average Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Average Detected Influent Concentration: | 0.70 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 641,860 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.6 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 6 | Loading to River: | 0.1 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.6 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 µg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 2 µg/L | From Table 4 |
| 15 | Mass Loading: | 163,512 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 1 µg/L | From Table 4 |
| 19 | Mass Loading: | 81,756 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 681300 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 1,323,160 µg or | Line 3 + Line 21 |
| 24 | | 1.3 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 1.1 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | From Table 3 |
| 27 | Loading to River: | 0.1 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.1 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 1.2 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,1-Dichloroethane (Average Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | | Source |
|---|---|---|---|---|
| 1 | Average Detected Influent Concentration: | ND | μg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 | gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 0 | μg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.0 | grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | NC | | From Table 3 |
| 6 | Loading to River: | 0.0 | grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.0 | grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | | |
| | ***MW23B*** | | | |
| 8 | Design Extraction Rate: | 16 | gpm or | Design Criteria |
| 9 | | 23,040 | gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 | μg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 | μg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | | |
| 12 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 13 | | 21,600 | gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 1.6 | μg/L | From Table 4 |
| 15 | Mass Loading: | 130,810 | μg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | | |
| 16 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 17 | | 21,600 | gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 1 | μg/L | From Table 4 |
| 19 | Mass Loading: | 81,756 | μg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | | |
| 20 | Overall Extraction Rate: | 66,240 | gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 648598 | μg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | | |
| 22 | Influent Flow Rate: | 310,240 | gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 648,598 | μg or | Line 3 + Line 21 |
| 24 | | 0.6 | grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 0.6 | μg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.1 | grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.1 | μg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 0.6 | grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for Trichloroethene (Average Influent Concentration)

**Basis: 24-hours**

| Line | | Value | Source |
|---|---|---|---|
| | ***Baseline Mass Loading*** | | |
| 1 | Average Detected Influent Concentration: | 2.24 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 2,064,625 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 2.1 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 80.0% | From Table 3 |
| 6 | Loading to River: | 0.4 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 1.7 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 52 µg/L | From Table 4 |
| 11 | Mass Loading: | 4,534,733 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 58 µg/L | From Table 4 |
| 15 | Mass Loading: | 4,741,848 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 5.2 µg/L | From Table 4 |
| 19 | Mass Loading: | 425,131 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 9,701,712 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 11,766,337 µg or | Line 3 + Line 21 |
| 24 | | 11.8 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 10.0 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 80.0% | From Table 3 |
| 27 | Loading to River: | 2.4 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 2.0 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 9.4 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,1, 1- Trichloroethane (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | | | Source |
|---|---|---|---|
| | ***Baseline Mass Loading*** | | |
| 1 | Maximum Detected Influent Concentration: | 3.40 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 3,140,036 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 3.1 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 81.2% | From Table 3 |
| 6 | Loading to River: | 0.6 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 2.5 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria' |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 µg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 10 µg/L | From Table 4 |
| 15 | Mass Loading: | 817,560 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 11 µg/L | From Table 4 |
| 19 | Mass Loading: | 899,316 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 2152908 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 5,292,944 µg or | Line 3 + Line 21 |
| 24 | | 5.3 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 4.5 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 81.2% | From Table 3 |
| 27 | Loading to River: | 1.0 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.8 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 4.3 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for trans 1,2 -Dichloroethene (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | | Source |
|---|---|---|---|---|
| 1 | Maximum Detected Influent Concentration: | ND | μg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 | gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 0 | μg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.0 | grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | NC | | From Table 3 |
| 6 | Loading to River: | 0.0 | grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.0 | grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | | |
| | ***MW23B*** | | | |
| 8 | Design Extraction Rate: | 16 | gpm or | Design Criteria |
| 9 | | 23,040 | gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 23 | μg/L | From Table 4 |
| 11 | Mass Loading: | 2,005,747 | μg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | | |
| 12 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 13 | | 21,600 | gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 4.6 | μg/L | From Table 4 |
| 15 | Mass Loading: | 376,078 | μg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | | |
| 16 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 17 | | 21,600 | gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 0.1 | μg/L | From Table 4 |
| 19 | Mass Loading: | 8,176 | μg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | | |
| 20 | Overall Extraction Rate: | 66,240 | gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 2390000 | μg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | | |
| 22 | Influent Flow Rate: | 310,240 | gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 2,390,000 | μg or | Line 3 + Line 21 |
| 24 | | 2.4 | grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 2.0 | μg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.3 | grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.2 | μg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 2.1 | grams per day | Line 24 - Line 27 |

**Mass Balance Calculations for Tetrachloroethene (Maximum Influent Concentration)**

**Basis: 24-hours**

| Line | | | Source |
|---|---|---|---|
| | ***Baseline Mass Loading*** | | |
| 1 | Maximum Detected Influent Concentration: | 130 μg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 120,060,200 μg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 120.1 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 91.1% | From Table 3 |
| 6 | Loading to River: | 10.6 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 109.4 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 1,600 μg/L | From Table 4 |
| 11 | Mass Loading: | 139,530,240 μg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 2,300 μg/L | From Table 4 |
| 15 | Mass Loading: | 188,038,800 μg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 880 μg/L | From Table 4 |
| 19 | Mass Loading: | 71,945,280 μg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 399,514,320 μg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 519,574,520 μg or | Line 3 + Line 21 |
| 24 | | 519.6 grams | Line 23 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 442.5 μg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 91.1% | From Table 3 |
| 27 | Loading to River: | 46.0 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 39.2 μg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 473.6 grams per day | Line 24 - Line 27 |

**Mass Balance Calculations for cis 1,2-Dichloroethene (Maximum Influent Concentration)**

**Basis: 24-hours**

| Line | | Value | | Source |
|---|---|---|---|---|
| | ***Baseline Mass Loading*** | | | |
| 1 | Maximum Detected Influent Concentration: | 2.54 | µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 | gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 2,345,792 | µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 2.3 | grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 88.7% | | From Table 3 (Average VOC Removal Eff.) |
| 6 | Loading to River: | 0.3 | grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 2.1 | grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | | |
| | ***MW23B*** | | | |
| 8 | Design Extraction Rate: | 16 | gpm or | Design Criteria |
| 9 | | 23,040 | gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 1200 | µg/L | From Table 4 |
| 11 | Mass Loading: | 104,647,680 | µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | | |
| 12 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 13 | | 21,600 | gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 270 | µg/L | From Table 4 |
| 15 | Mass Loading: | 22,074,120 | µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | | |
| 16 | Design Extraction Rate: | 15 | gpm or | Design Criteria |
| 17 | | 21,600 | gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 8.9 | µg/L | From Table 4 |
| 19 | Mass Loading: | 727,628 | µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | | |
| 20 | Overall Extraction Rate: | 66,240 | gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 127449428 | µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | | |
| 22 | Influent Flow Rate: | 310,240 | gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 129,795,220 | µg or | Line 3 + Line 21 |
| 24 | | 129.8 | grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 110.5 | µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 14.6 | grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 12.5 | µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 115.2 | grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,2-Dichloroethane (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | | | Source |
|---|---|---|---|
| | ***Baseline Mass Loading*** | | |
| 1 | Maximum Detected Influent Concentration: | ND µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 0 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.0 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | NC | From Table 3 |
| 6 | Loading to River: | 0.0 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.0 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 µg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 0.5 µg/L | From Table 4 |
| 15 | Mass Loading: | 40,878 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 1 µg/L | From Table 4 |
| 19 | Mass Loading: | 81,756 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 558666 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 558,666 µg or | Line 3 + Line 21 |
| 24 | | 0.6 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 0.5 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.1 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.1 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 0.5 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,1-Dichloroethene (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Maximum Detected Influent Concentration: | 1 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 923,540 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.9 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 64.0% | From Table 3 |
| 6 | Loading to River: | 0.3 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.6 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 µg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 2 µg/L | From Table 4 |
| 15 | Mass Loading: | 163,512 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 1 µg/L | From Table 4 |
| 19 | Mass Loading: | 81,756 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 681300 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 1,604,840 µg or | Line 3 + Line 21 |
| 24 | | 1.6 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 1.4 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.2 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.2 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 1.4 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for 1,1-Dichloroethane (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Maximum Detected Influent Concentration: | ND μg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 0 μg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 0.0 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | NC | From Table 3 |
| 6 | Loading to River: | 0.0 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 0.0 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 5 μg/L | From Table 4 |
| 11 | Mass Loading: | 436,032 μg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 1.6 μg/L | From Table 4 |
| 15 | Mass Loading: | 130,810 μg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 1 μg/L | From Table 4 |
| 19 | Mass Loading: | 81,756 μg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 648598 μg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 648,598 μg or | Line 3 + Line 21 |
| 24 | | 0.6 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 0.6 μg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 88.7% | From Table 3 (Average VOC Removal Eff.) |
| 27 | Loading to River: | 0.1 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 0.1 μg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 0.6 grams per day | Line 24 - Line 27 |

## Mass Balance Calculations for Trichloroethene (Maximum Influent Concentration)

**Basis: 24-hours**

| Line | *Baseline Mass Loading* | | Source |
|---|---|---|---|
| 1 | Maximum Detected Influent Concentration: | 5.33 µg/L | From Table 1 |
| 2 | Existing Influent Flow Rate: | 244,000 gpd | From NPDES Permit Reports |
| 3 | Mass Loading: | 4,922,468 µg or | Line 1 x Line 2 x 3.785 liters per gallon |
| 4 | | 4.9 grams | Line 3 / 1,000,000 micrograms per gram |
| 5 | Removal Efficiency: | 80.0% | From Table 3 |
| 6 | Loading to River: | 1.0 grams per day | (1 - Line 5) x Line 4 |
| 7 | Discharge to Air: | 3.9 grams per day | Line 4 - Line 6 |
| | ***Mass Loading Associated With New Wells*** | | |
| | ***MW23B*** | | |
| 8 | Design Extraction Rate: | 16 gpm or | Design Criteria |
| 9 | | 23,040 gpd | Line 8 x 60 min/hour x 24 hours/day |
| 10 | Influent Concentration: | 52 µg/L | From Table 4 |
| 11 | Mass Loading: | 4,534,733 µg | Line 9 x Line 10 x 3.785 liters/gallon |
| | ***GW07*** | | |
| 12 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 13 | | 21,600 gpd | Line 12 x 60 min/hour x 24 hours/day |
| 14 | Influent Concentration: | 58 µg/L | From Table 4 |
| 15 | Mass Loading: | 4,741,848 µg | Line 13 x Line 14 x 3.785 liters/gallon |
| | ***GW08*** | | |
| 16 | Design Extraction Rate: | 15 gpm or | Design Criteria |
| 17 | | 21,600 gpd | Line 16 x 60 min/hour x 24 hours/day |
| 18 | Influent Concentration: | 5.2 µg/L | From Table 4 |
| 19 | Mass Loading: | 425,131 µg | Line 17 x Line 18 x 3.785 liters/gallon |
| | **Combined (EW05, EW06 & EW07)** | | |
| 20 | Overall Extraction Rate: | 66,240 gpd | Line 8 + Line 12 + Line 16 |
| 21 | Mass Loading: | 9,701,712 µg | Line 11 + Line 15 + Line 19 |
| | **Overall System With New Wells** | | |
| 22 | Influent Flow Rate: | 310,240 gpd | Line 2 + Line 20 |
| 23 | Influent Mass Loading: | 14,624,180 µg or | Line 3 + Line 21 |
| 24 | | 14.6 grams | Line 24 / 1,000,000 micrograms per gram |
| 25 | Influent Concentration: | 12.5 µg/L | Line 23 / (Line 22 x 3.785 liters/gallon) |
| 26 | Removal Efficiency: | 80.0% | From Table 3 |
| 27 | Loading to River: | 2.9 grams per day | Line 24 x (1 - Line 26) |
| 28 | Effluent Concentration: | 2.5 µg/L | Line 23 / (Line 22 x 3.785 liters per gallon) |
| 29 | Discharge to Air: | 11.7 grams per day | Line 24 - Line 27 |

specimens for each composite sample.
b. Cast and field cure four (4) standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one (1) laboratory-cured specimen at seven (7) days, one (1) at fourteen (14) days and one (1) at twenty-eight (28) days. If the twenty-eight (28) day test specimen shows that concrete has not come up to the required compressive strength, then test the remaining specimen.
7. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within forty-eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty-eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7)- and twenty-eight (28)-day tests.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Measure floor and slab flatness and levelness according to ASTM E 1155 within twenty-four (24) hours of finishing.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 REQUIREMENTS

A. This section is coordinated with and complementary to other applicable sections of these Specifications.

B. General equipment requirements specified hereinafter shall apply to Divisions 11, 13, 15, and 16 of the Specifications.

C. Unless otherwise specified, all electrical work, materials, and equipment provided under equipment and mechanical sections of the Specifications shall conform to the requirements of Division 16 of the Specifications.

### 1.2 STANDARDS

A. Where the following standards, codes, or Specifications are referred to in the electrical and mechanical Specification sections, the reference is to the particular standard, code, or Specifications, together with all amendments and errata applicable at the time the bids are taken.

| Abbreviation | Description |
|---|---|
| AAMA | Architectural Aluminum Manufacturers Association |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| AGA | American Gas Association |
| AGMA | American Gear Manufacturers Association |
| AISC | American Institute of Steel Construction |
| AMCA | Air Moving and Conditioning Association, Inc. |
| ANSI | American National Standards Institute, Inc. |
| ASCE | American Society of Civil Engineers |
| ASHRAE | American Society of Heating, Refrigerating, and Air Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWSC | American Welding Society Code |
| AWWA | American Water Works Association |
| CIPRA | Cast Iron Pipe Research Association |
| CRSI | Concrete Reinforcing Steel Institute |
| ETL | Electrical Testing Laboratories, Inc. |
| IEEE | Institute of Electrical and Electronic Engineers |
| JIC | Joint Industry Conference |
| MSS | Manufacturer's Standardization Society of the Valves and Fittings Industry |
| NBS | National Bureau of Standards |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| OSHA | Occupational Safety and Health Administration |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |

| | |
|---|---|
| SSPC | Steel Structures Painting Council |
| UL | Underwriters' Laboratories, Inc. |
| USASI | United States of America Standards Institute |

## 1.3 SUBMITTALS

A. Manufacturers' product Specifications; data sheets; catalog cuts; installation, operation and maintenance (O&M) manuals; and fabrication Drawings.

## 1.4 SPECIFIED EQUIPMENT AND MATERIALS

A. Unless otherwise indicated, Specifications or Drawing references to manufacturer's names and/or model numbers are provided as a guide to bidding and to establish the type, grade, or quality of equipment or materials required. Where the words "or equal" are used, equivalent items may be substituted. All substituted items are subject to review and acceptance by the Engineer. In all cases, the Contractor shall be responsible for providing equipment and materials that satisfy the indicated requirements.

B. Equipment and appurtenances shall be designed in conformity with generally accepted applicable standards and shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operation. All bearings and moving parts shall be protected adequately by bushings or other suitable means against wear, and provision shall be made for adequate lubrication by readily accessible devices.

C. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds shall be ground smooth, and the corners of structural shapes shall be rounded or chamfered. Machinery parts shall conform within allowable tolerances to the dimensions shown on the Drawings.

D. Corresponding parts of identical equipment shall be interchangeable.

E. All equipment shall be safeguarded in accordance with applicable federal, state, and local safety codes.

F. The Contractor shall furnish, for each piece of equipment, any and all special tools and appliances that may be needed to adjust, maintain, or repair the equipment. All such tools shall be boxed and labeled suitably and shall be stored as directed by the Engineer.

G. The Engineer reserves the right to select the equipment based on data submitted and to reject equipment where no information has been provided.

## 1.5 CORROSION PROTECTION

A. All equipment furnished under this Contract shall be corrosion-protected by the manufacturer or supplier before shipment. All surfaces subject to corrosion shall be coated with suitable rust-preventing compounds before shipment. Where equipment is shipped in protective crates and boxes, parts may be sealed in heavy-duty plastic. Where special on-site protection is required, the Contractor shall protect equipment in accordance with manufacturer's recommendations.

B. All spare parts shall be coated properly to withstand the corrosive effects of a moist atmosphere. All spare parts shall be crated properly in containers for prolonged periods of storage and for handling with hoisting equipment. Wherever possible, wooden crates of durable construction shall be utilized. All containers shall have stenciled thereon the name of the manufacturer or supplier providing the item of equipment; the name of unit for which the spare part is intended; the name of spare part; the name of manufacturer of spare part, if different from manufacturer or supplier of the equipment item; the manufacturer's catalog numbers; and all other identifying and precautionary information.

C. Aluminum shall not be used in contact with earth. Dissimilar metals in close contact shall be protected by suitable fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized.

## 1.6 RECORD DRAWINGS

A. The Contractor shall provide and keep up to date a complete record set of Drawings, which shall be corrected and show every change from the original Specification and Drawings. Prints for this purpose may be obtained from the Engineer. This set of prints shall be kept on the job and shall be used only as a record set. This shall not be construed as authorization for the Contractor to make changes in the layout without approval. Upon completion of the work and before final payment, the record Drawings (as-built) shall be submitted for approval. Upon approval, the Agency will retain the record set.

## 1.7 MANUFACTURERS AND PRODUCTS

A. The manufacturer of each piece of equipment specified shall have been in the business of manufacturing such equipment for at least three years unless otherwise specified. Products supplied shall be the standard products of each manufacturer unless otherwise specified or approved.

## 2.0 PRODUCTS

## 2.1 EQUIPMENT GUARDS

A. Safety guards shall be provided on all belt drives, couplings, and other rotating or moving machinery. Guards shall be rigid, of heavy-(minimum 14)-gauge steel construction, hot-dip galvanized or with factory-applied finish after fabrication, and finished to match the equipment. Guards shall be readily removable.

## 2.2 LUBRICATION

A. Unless otherwise specified, all bearings shall be the equipment manufacturer's standard for the indicated service. Where bearing types are optional, the pressure grease-lubricated type shall be provided. All lubrication points shall be readily accessible, away from locations dangerous to workers. Pressure grease-lubrication fittings shall be provided. The Contractor shall notify and coordinate all equipment suppliers to provide one type of lubrication fitting for all equipment furnished under this Contract. The pattern of the fittings shall be selected for accessibility in lubricating and shall be acceptable to the Engineer.

B. The Contractor shall furnish a pressure grease gun having a capacity of not less than 1.75 pounds of grease.

C. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point for lubrication, the type lubricant to be supplied, and the frequency of lubrication. Charts and schedules shall be provided to the Engineer.

D. The Contractor shall furnish one 5-pound container of each type of lubricating grease required to service equipment and a sufficient quantity of each required type of lubricating oil for one complete oil change for each item of equipment containing lubricating oil, in addition to the initial oil fill. This is in addition to providing lubricants during operation of the treatment plant.

### 2.3 PAINTING

A. Unless otherwise specified, all equipment shall be provided with the manufacturer's standard shop painting coat. Equipment such as ventilators and other packaged equipment shall be furnished with the manufacturer's standard enamel finish.

### 2.4 SPARE PARTS

A. The Contractor shall include in the bid price such spare parts as specified in the sections for the various items of equipment.

## 3.0. EXECUTION

### 3.1 FIELD CONDITIONS AND MEASUREMENT

A. The Contractor shall base all measurements, horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. The Contractor shall verify all conditions at the site.

B. Should the Contractor discover any discrepancy between actual conditions and those indicated that prevents following good practice or the intent of the Drawings and Specifications, he/she shall notify the Engineer and shall not proceed with his/her work until he/she has received instructions from the Engineer.

### 3.2 SUPPLEMENTARY SUPPORTING STEEL

A. All supplementary supporting steel required to support ducts, piping, electrical services, equipment, and appurtenances shall be provided by the Contractor.

## 3.3 CUTTING, PATCHING, AND WATERPROOFING

A. All holes cut through equipment shall be saw-cut, core-drilled, or drilled. No structural members shall be cut without written permission of the Engineer, and such cutting shall be done in a manner directed by him/her.

B. Holes shall be patched using the same materials as originally used. Finish of patched areas shall match and blend into adjacent existing finished areas. All work shall be completed to the satisfaction of the Engineer.

C. Where any work pierces waterproofing, including container wall material, the method of installation shall be acceptable to the Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking, and flashing required to make openings absolutely watertight. The installation shall be performed by the installing Contractor.

## 3.4 FOUNDATIONS, SUPPORTS, AND PIERS

A. The intent of the Contract documents is to provide a complete, functional system. All necessary appurtenances, supports, and foundations, whether shown on the *Drawings or detailed in the Specifications, are to be considered implied and shall* be furnished and installed by the Contractor for equipment, piping, conduit, pumps, tanks, and all other equipment furnished under this Contract.

B. In general, all equipment, pumps, motor control centers, and control panels shall be mounted on four (4)-inch-minimum-high, steel angle-support bases.

## 3.5 INSTALLATION

A. The Contractor shall install all equipment in accordance with the recommendations of the manufacturer. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor bolts, and fasteners, and all other appurtenances required for the installation of equipment specified. Anchor bolts shall be galvanized steel of sufficient size and strength for the purpose intended.

B. Unless otherwise specified, the Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for delivery of all equipment and erection at the locations and elevations shown on the Drawings.

C. All equipment anchored on concrete or masonry foundations shall be bedded properly using a non-shrink cement grout. The grout shall completely fill all voids between the equipment base and the foundation.

D. Mechanical units shall be factory-assembled insofar as practical.

E. *Work shall not be covered up or enclosed until it has been inspected, tested, and* approved. Any work that is enclosed or covered up before such inspection and test shall be uncovered, and after it has been inspected and approved, it shall be restored to its original condition at no additional cost to the Engineer.

## 3.6 IDENTIFICATION OF EQUIPMENT

A. In addition to the manufacturer's nameplates, all equipment, such as fans, pumps, and tanks, shall be identified permanently by name and number corresponding to the Specifications and Drawings. Each motor shall be identified by the same number as the driven unit. Identifying characters shall be not less than two (2) inches high and shall be painted in a professional manner acceptable to the Engineer.

B. All valves and instrumentation shall be tagged plainly with numbered, lacquered brass tags, their location and number corresponding to those indicated in the Specifications, shown on the Drawings, or provided by the Engineer. Tags shall not be less than one and one-half (1.5) inches in diameter with black figures stamped and painted on the tags before lacquering. Tags shall be fastened by open-link brass chains to bodies of valves.

## 3.7 QUIET OPERATION

A. Under all normal operating conditions, all systems and equipment shall operate without objectionable noise or vibration. Any condition that is objectionable in the opinion of the Engineer shall be corrected by the Contractor in a manner acceptable to the Engineer and at no additional cost to the Engineer or Owner.

## 3.8 CLEANING

A. Exposed surfaces of pipes; tanks; equipment; and building walls, floor, and ceiling that have become covered with dirt or other material during handling and installation shall be cleaned thoroughly before final acceptance.

## 3.9 DAMAGE TO WORK

A. Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Engineer at no additional cost to the Engineer or Owner.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SCOPE

A. This section includes the requirements for provision and installation of water pumps and associated electric drive units for the ISCA P&T system modifications.

### 1.2 RELATED WORK

A. Section 02750 – Extraction Well Construction
B. Section 11010 – General Equipment Requirements.
C. Section 15060 – Process Pipe and Fittings.
D. Section 15100 – Valves and Appurtenances.
E. Section 15122 – Meters and Gauges.

### 1.3 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

### 1.4 SUBMITTALS

A. Drawings: The manufacturer shall provide such Drawings and/or catalog cuts required for evaluation by the Engineer. These Drawings shall be accurate in every detail and shall contain all of the information necessary to relate the equipment to the Specifications. Complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

B. Materials of construction, utility requirements, and equipment weight shall be provided. Pump characteristic curves showing capacity in gallons per minute (gpm), net positive suction head (NPSH), head, efficiency, and pumping horsepower from 0 gpm to 110 percent (100 percent for positive displacement pumps) of design capacity. A complete list of equipment and material, including pump characteristics and curves, manufacturer's descriptive data and technical literature, catalog cuts, performance charts and curves, installation instructions, and spare parts data shall be provided. Diagrams, instructions, and other sheets proposed for posting.

C. One complete set of operation and maintenance manuals for the equipment furnished prior to performance testing. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

D. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

**1.5 WARRANTY**

A. Mechanical: All equipment shall be warranted to be free of defects in material and workmanship for a period of one (1) year from the date of acceptance by the Engineer.

B. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the manufacturer shall repair or replace such defective part.

**1.6 FIELD MEASUREMENTS**

A. Become familiar with all details of the work, verify all dimensions in the field, and advise the Engineer of any discrepancy before performing the work.

**1.7 SPARE PARTS**

A. Submit spare parts data for each different item of material and equipment specified, after approval of the related submittals, and not later than one (1) month prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

**2.0 PRODUCTS**

**2.1 GENERAL**

A. Contractor shall supply only new equipment.

**2.2 INFLUENT EQUILIZATION TANK PUMP**

A. Design Data

a. Capacity shall be four hundred (400) gpm at twenty-nine (29) feet total dynamic head.

b. The motor shall be a thirty six hundred (3,600) rpm, five (5) horsepower, sixty (60) Hertz, three (3) phase open drip proof motor.

B. The equalization tank pump and motor shall be the Goulds pump model number 3656/3756-3, part number 6BF1L2E0, or engineer approved equivalent.

## 2.3 EXTRACTION WELL PUMP

A. Design Data
   a. Capacity shall be twenty-five (25) gpm at eighty-five (85) feet total dynamic head.
   b. The motor shall be Franklin one (1) horsepower, rated for two hundred thirty (230) volts, one (1) phase, two (2) wire, sixty (60) Hertz pollution recovery motor.
   c. The selected pump is provided with one and one-half (1-1/2) inch NPT discharge flange.
   d. The cable between the motor and the above ground connection shall be at least seventy-five (75) feet in length.

B. Extraction well pump and motor shall be Grundfos Model 25E4, or Engineer approved equivalent.

## 2.4 EXTRACTION WELL PUMP DESIGN AND MATERIALS OF CONSTRUCTION

A. There shall be a built-in check valve made of 300 Series stainless steel. The check valve seat shall be Teflon with a 300 Series stainless steel insert.

B. The pump bowls, impellers, guide vanes and filter screen shall be 300 Series stainless steel.

C. Each impeller shall have a Teflon seal ring around its eye or skirt to reduce hydraulic losses.

D. A 300 Series stainless steel filter screen shall be included as part of the suction inlet assembly.

E. A 300 Series stainless steel priming inducer shall be included to provide lubricating flow and to prime the pump should the fluid pumping level fall below the first impeller.

F. The stainless steel nameplate shall be affixed to the pump. The pump model shall be stamped into the nameplate. No inks or dyes shall be used.

## 2.5 EXTRACTION WELL MOTOR DESIGN AND MATERIALS OF CONSTRUCTION

A. The motor shall be a squirrel-cage induction motor designed for submersible operation in conformance with NEMA standards.

B. All materials in contact with the pump fluids shall be 300 Series stainless steel or Viton.

C. The motor shall not use any oils or greases for lubrication of bearings.

D. A flexible Viton diaphragm shall be provided to permit expansion and contraction of the internal motor lubricating and cooling fluid.

E. The motor shaft seal shall be constructed of Viton.
F. A sand slinger made of Viton shall be included.

## 2.6 EXTRACTION WELL MOTOR CABLE DESIGN AND MATERIALS OF CONSTRUCTION

A. The cable shall be continuous with no splices.
B. The connector boot shall be constructed of Viton. The connector shall be constructed of 300 Series stainless steel. The motor wire shall be AWG12 with Teflon insulation.

## 2.7 SUMP PUMP

A. Design Data
   a. Capacity shall be fifteen (15) gpm at seven (7) feet total dynamic head.
   b. The motor shall be a three thousand (3,000) rpm, one quarter (1/4). Horsepower and one (1) phase
   c. The selected pump is provided with one-half (1-1/2) inch NPT discharge flange
B. Grundfos pump model number SU 25 part number SU-251A/08, or engineer approved equivalent.

# 3.0 EXECUTION

## 3.1 EQUIPMENT INSTALLATION

A. Pumping equipment and appurtenances shall be installed in the position indicated and in accordance with the manufacturer's written instructions. All appurtenances required for a complete and operating pumping system shall be provided, including such items as piping, conduit, valves, wall sleeves, wall pipes, concrete foundations, anchors, grouting, pumps, drivers, power supply, seal water units, and controls.

## 3.2 PAINTING

A. Pumps and motors shall be thoroughly cleaned, primed, and given two (2) finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Field painting required for ferrous surfaces not finished at the factory.

## 3.3 FIELD TESTING AND ADJUSTING EQUIPMENT

A. Contractor shall notify the Engineer at least three (3) business days in advance of all tests. All tests shall be conducted to the Engineer's complete satisfaction.
B. Prior to acceptance, an operational test of all pumps, drivers, and control systems

shall be performed to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally, or otherwise defective; is in safe and satisfactory operating condition; and conforms with the specified operating characteristics. Prior to applying electrical power to any motor driven equipment, the drive train shall be rotated by hand to demonstrate free operation of all mechanical parts. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels, and power consumption.

C. Any deficiencies revealed during any test shall be corrected and the tests shall be re-conducted.

*** END OF SECTION ***

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SECTION 13125
METAL BUILDING SYSTEMS

## 1.0 GENERAL

## 1.1 SUMMARY

A. Furnish, and install one (1) pre-assembled, pre-engineered, steel building without floor, complete with all materials and accessories as needed for a complete building as shown on the drawings and as specified herein. The building shall be a structurally steel framed, "TRACHTE POWER HOUSE™" design, manufactured with Channelframe™ construction.

B. Design and installation of the building foundations.

1. Obtain soil data and information, design building foundations, and provide foundation construction drawings.

## 1.2 RELATED WORK

A. Section 01330 – Contractor Submittals.

B. Section 03300 – Cast-In-Place Concrete.

C. Drawings.

## 1.3 REFERENCE STANDARDS

A. ACI 318, Building Code Requirements for Structural Concrete.

B. ASTM A36, Carbon Structural Steel.

C. ASTM A653, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. ASTM A924, Steel Sheet, Metallic-Coated by the Hot-Dip Process.

E. NEC 2007, National Electric Code.

F. SDI-111, Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories.

## 1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01330, CONTRACTOR SUBMITTALS.

B. Building drawings sealed by an Illinois Structural Professional Engineer.

C. Tabulations of building loadings due to snow loads, wind loads and other dead and live loads as defined by Illinois Building Codes sealed by an Illinois Structural Professional Engineer.

D. Soil data necessary to design the building foundations, including bearing strength and other data as needed, and sealed by an Illinois Structural Professional Engineer. The soil data, including the boring logs and other data, shall be obtained by an approved soil investigation firm.

E. Foundation design drawings prepared sealed by an Illinois Structural Professional Engineer using the soil data obtained as described in paragraph C above.

F. Qualification Data: For concrete testing agency and soil investigation firm.

G. Name, address, phone number and State Professional Engineer License number of the foundation design Engineer.
H. Sealed building drawings and load tables and foundation drawings.
I. Electronic copies of the design calculations for the foundation and building.
J. Certified compliance with energy codes if required by State or local Codes.

## 1.5 DESIGN REQUIREMENTS

A. Codes and Standards. The structure design and manufacture shall, as a minimum, conform to ASCE (American Society of Civil Engineers) current edition of "Minimum Design Loads for Buildings and Other Structures" and to the MBMA (Metal Building Manufacturers Association) "Recommended Design Practices Manual." Building shall be manufactured and built to satisfy the Current Editions of the International Building Code (IBC), and the National Electrical Code (NEC). Building Manufacturer shall supply plans and calculations stamped by an Illinois Registered Professional Engineer, and is responsible for obtaining any State Industrial Building Commission Approvals and Third Party Inspections if required.
B. The building and foundations shall be designed to support the following loads unless State or local Building Codes require higher loadings:
   1. Roof Load – Fifty (50) PSF (forty (40) psf live and ten (10) psf dead).
   2. Ceiling Dead Load – Ten (10) PSF.
   3. Wall Load – One hundred ten (110) mph wind, plus wall mounted equipment.
   4. Seismic Zone – Per State Building Codes for site.

C. Foundation design shall conform to applicable sections of ACI 318 and CRSI standards. (A preliminary foundation design has been prepared by the Engineer using the design criteria given in Section 03300, CAST-IN-PLACE CONCRETE and an assumed soil bearing strength. The foundation design Professional Structural Engineer should use this preliminary foundation design as a suggested final foundation layout.)
D. Foundation dimensions shall be suitable for the building proposed. Coordinate dimensions with steel building manufacturer's building drawings.

## 1.6 BUILDING DRAWING SUBMITTAL SCHEDULE

A. Within two (2) weeks of notice to proceed, submit four (4) sets of Manufacturer-prepared Approval Drawings and an electronic file copy of same in Adobe PDF format to the engineer for review. The drawings shall show at a minimum the building floor plan, interior and exterior dimensions, elevations, suggested foundation elevations and dimensions, and the location of all primary accessories included with the building.
B. Submit a standard color chart to the Engineer for exterior color selection prior to manufacturing.
C. Two (2) sets of digital files of each final shop drawing and final fabrication drawing shall be sent on disc to the Engineer at the time of shipping. One (1) set of Digital

files shall be in Adobe PDF format. The other digital file shall be in AutoCAD 2005 format.

## 1.7 BUILDING FOUNDATION DRAWING SUBMITTAL SCHEDULE

A. Within five (5) weeks of notice to proceed, submit four (4) sets of foundation Approval Drawings to the engineer for review. The drawings shall show at a minimum the foundation plan, sections, and details suitable for construction and the specific project. All dimensions, elevations, foundation top and bottom elevations, reinforcing steel sizes and placement, pipe penetration details and other foundation requirements shall be shown.

## 1.8 QUALITY ASSURANCE

A. Building Manufacturer to have a Quality Control program that follows building through to completion and is passed on to Owner with all instruction manuals and final drawings. Additionally, the building manufacturer to have been in the control building business for a minimum of five (5) years, and able to supply proof of supplying at least twenty-five (25) buildings of a similar type in that time.

## 1.6 BUILDING WARRANTY

A. Manufacturer shall guarantee that the complete building will have no defects in materials and workmanship for a period of two (2) years after date of installation, except as extended by the original equipment or component manufacturer.

B. Metal Exteriors and Roofing shall have a baked-on PVDF resin based paint coating, over either a Galvalume or galvanized substrate, with a twenty (20) year Warranty against rust perforation, a thirty (30) year Warranty against fading and chalking, and a forty (40) year Warranty against flaking peeling and checking. Coatings to meet minimum performance requirements as set forth in ASCA specification 96 and AAMA specification 2605. Provide KYNAR 500 or approved equal coating.

## 2.0 MATERIALS

## 2.1 BUILDING MATERIALS

A. Building materials shall be new, unused, and fabricated in a workmanlike manner in a factory environment. Hot rolled steel to meet as a minimum standard ASTM A36, and all galvanized steel to meet as a minimum standard ASTM A 653.

B. Building components and building parts shall be clearly marked on the manufacturer prepared drawings.

## 2.2 FOUNDATION MATERIALS

A. Use concrete, reinforcing steel and other materials as specified in Section 03300, CAST-IN-PLACE CONCRETE and as certified by the Illinois Structural Professional Engineer sealing the foundation design.

## 2.3 BASE PERIMETER ANGLE SYSTEM

A. Building base shall have a hot rolled steel angle framework, welded, primed and painted, with minimum deflection of L/240. Base shall be pre-drilled for anchoring to a concrete slab with expansion anchors. Building and process tank foundation shall be designed by an Illinois Professional Engineer retained by Contractor.

B. Base framework to be fully cleaned, primed and painted with a self-priming, VOC compliant, catalyzed coating system designed to provide an extremely durable finish, suitable for heavy industrial, severe coastal, chemical, or off shore environments with superior corrosion protection and resistance to fading. Paint system to have a minimum Dry Film Thickness, per coat of five to seven (5-7) mils. Color to be Navy Gray. The coating shall be Sherwin Williams Macropoxy 646 Fast-Cure Epoxy with a minimum dry film thickness of five to seven (5-7) mils or approved equal.

C. Welds shall, as a minimum, meet AWS recommended practices.

D. Heavy duty steel lift eyes to be supplied and mounted to the roof trusses as needed for lifting the building.

E. Ground lugs to be bolted to frame where indicated on Drawings or where required by Codes.

## 2.4 BUILDING

A. **Framework:** The building shall have a complete, internal, self-supporting, structural steel frame which does not rely on the exterior panels or roof cover panels for any of its structural strength or framing. The building framework shall include eight to sixteen (8 to 16) gauge, cold-formed, galvanized steel structural members. Building framework to have a flush wall, post and beam format with girts and purlins, and full trusses on both endwalls which easily allows for future expansion and/or modifications. Wall and ceiling structural support system are to be designed to provide load carrying capability for anticipated equipment loads using sixteen (16) gauge galvanized steel hat channels behind liner panel for reinforcement as needed, with locations shown on approval drawings. Roof to have eight to fourteen (8 to 14) gauge solid web hot rolled steel trusses and be designed to safely carry the process pipe, and other process related appurtenances, shown on the drawings.

B. **Insulation:** Exterior walls shall have a minimum of three and one-half (3.5) inches of fiberglass batt insulation and a vapor barrier. The ceiling shall have a minimum of six (6) inch cellulose insulation and a vapor barrier. In addition to the insulation in the walls and ceiling, an additional one (1) inch cellulose insulation blanket shall be installed over the entire building framework and under the exterior wall and roof panels, as a thermal break. The insulation system shall provide a minimum of R-19 in the walls, R-24 above the ceiling, and R-30 in the floor. Cellulose to have a minimum flame spread rating of five (5).

C. **Roof:** A roof pitched one (1) inch in twelve (12) inches or greater shall have a covering of overlapping, eighteen (18) gauge, G-90 galvanized, ribbed steel panels with a baked-on Kynar 500, PVDF resin-based finish in manufacturer's standard colors. Overlapping roof panels shall be installed with appropriate self-tapping fasteners with integral gaskets. A roof with a pitch of less than one (1) inch in twelve (12) inches shall have a roof covering of mechanically-seamed, twenty-four (24) gauge, Standing-Seam Roofing, with a minimum seam height of two (2) inches. Standing seam roof panels shall be of Galvalume steel, with a baked-on Kynar 500, PVDF resin-based coating and shall have no visible fasteners on main run. Roof to include a matching, die-formed ridge cap, and a fully supported three (3) inch overhang. Properly sized attic space ventilation shall be provided.

D. **Exterior Walls:** The exterior walls shall be eighteen or twenty-four (18 or 24) gauge ribbed G-90 galvanized steel panels with a baked-on PVDF resin-based finish in manufacturer's standard colors. Exterior siding panels to be overlapped and installed with appropriate self-tapping fasteners with integral gaskets, and shall be removable without any disturbance to interior panels. Butted seams are not allowed. All openings in walls are to be structurally framed, sleeved, trimmed, and provided with external drip caps. Repair or replacement of exterior panels must be able to be done entirely from outside.

E. **Exterior Trim:** The exterior trim package shall include stepped or boxed eave, rake, fascia, base, corner, jamb, and header trim in, twenty-six (26) gauge Galvalume material with owner's choice of standard KYNAR colors.

F. **Interior Finish:** The building's interior walls and ceiling shall be lined with flush-fit twenty-two (22) gauge, roll-formed liner panels, with concealed fasteners and a baked-on White polyester finish over G-90 galvanized substrate. The building interior shall feature a complete matching trim system including base, jamb, header, and ceiling trim.

G. **Interior Dimensions:** The building's finished interior dimensions shall be no less than ten and one-half (10-½) inches in width and length from the exterior dimensions shown on the drawings. Minimum floor to ceiling dimension shall be nominal ten (10) feet.

H. **Fasteners, Adhesives, and Sealants:** The fasteners, adhesives, and sealants utilized shall be of types approved for use on this type of structure as required by the appropriate agency or governing body, as covered in section 1.5 of these specifications.

I. **Closures:** Matching, pre-molded, closed cell elastomer closures provided by the siding and roof panel manufacturer shall be installed according to the manufacturer's recommendations at the eave line, beneath the roof panels, and where the trim meets the wall panels.

J. **Attachment to Existing Building:** The roof and walls of the new building shall be supported by the existing building. The joints shall be sealed against the weather in a manner as determined by the building manufacturer to prevent entry of wind, water, etc.

K. **Existing Foundation Verification:** The Illinois Structural Professional Engineer shall verify that the foundation of the existing building can accommodate the loads imposed by the new building.

## 2.5 DOORS AND HARDWARE

A. **Minimum Standards:** Doors shall at a minimum comply with Steel Door Institute directive SDI-111. The exterior roll up door shall have operable exterior locking hardware with capability of unlocking the door from the interior. The interior man door shall be the building manufacturer's standard insulated interior man door.

B. **Doors and Frames**: Doors to be constructed of no less than eighteen (18)-gauge steel faced leafs with stiffeners and sixteen (16) gauge door frames. Doors and frames to be hot-dipped galvanized to ASTM designations A924 and A653, then factory primed and painted with epoxy enamel to match the building or the trim. The doors shall have insulated cores.

C. **Sizes and Quantity:** Shall be as indicated on the drawings.

D. **Door Hardware:** Provide the building manufacturer's standard locking hardware. Locks shall be operable from both sides.

## 2.6 MISCELLANEOUS BUILDING ACCESSORIES

A. **Telecommunications Board:** If indicated on the drawings, building manufacturer to install a seven-sixteenths (7/16) inch thick White FRP veneer plywood telecommunications board over a seven-sixteenths (7/16) inch OSB backer with flush transition trim to wall liner. Painted plywood fastened over the wall liner is not acceptable. Size and quantity to be as indicated on drawing or in the BOM.

B. **Emergency Eye Wash:** Building manufacturer shall install a wall mounted self contained emergency eye wash station containing, at a minimum, two (2) sixteen (16) ounce bottles of sterile saline solution.

C. **Fire Extinguisher:** Wall mounted ten pound (10#) Dry Chemical ABC Rated Fire Extinguishers shall be provided in a convenient location at each doorway.

## 2.7 HEATING, VENTILATION, AND AIR CONDITIONING

A. **Minimum Standards:** Unit(s) shall be a readily available wall mounted commercial grade heater. All electrical connections to meet NEC standards. Unit(s) to be supplied by a manufacturer with service representation within a two hundred fifty (250) mile radius of area where building is installed.

B. **Size and Quantity.** Unit(s) shall be sized by building manufacturer to maintain a minimum interior temperature of forty degrees Fahrenheit (40° F), and a maximum interior temperature of seventy-two degrees Fahrenheit (72° F). Quantity shall be as determined by building manufacturer. Power feed will be 208/240 VAC, single phase unless noted otherwise on the drawings.

C. **Filters and Controls**. Unit(s) shall have supply and return grilles and a replaceable pleated high efficiency filter on the return side. Unit(s) shall be controlled by a separate wall mounted auto-change over thermostat or a lead-lag controller if two (2) units are used.

D. **Exhaust Fan:** Intake shall have a filter rack, pleated high efficiency filter, insect screens and painted steel weather hood. Exhaust shall have a back draft damper, insect screen, and painted steel weather hood. Units shall be louvered aluminum with gravity dampers. Intake and exhaust to be sized by building manufacturer based on size of the building. Exhaust fan shall be controlled by a manual on-off switch. Power feed will be 120 VAC, single phase unless noted otherwise on the drawings.

## 2.8 BUILDING ELECTRICAL – STANDARDS

A. **Minimum Standards:** All grounding, workmanship and materials shall conform, as a minimum, to the National Electric Code, latest edition. All conduit shall be electrical thin wall metallic tubing (EMT) except service runs which are PVC, and flexible metallic conduit used for motor and fixture connections. All interior junction boxes, cabinets, etc. shall be NEMA rated for high moisture environment. All wiring and conduit shall be surface mounted and run tight to walls and ceiling. Conductors shall be ninety-eight percent (98%) conductivity copper with six hundred (600) volt insulation, THHN, sized as required, twelve (12) gauge minimum for line voltage wiring and eighteen (18) gauge for alarms.

## 2.9 LIGHTING

A. **Interior Lighting:** Building to be equipped with four (4) foot twin tube thirty-two (32) or forty (40) watt fluorescent light fixtures with rapid start ballasts, lamps, and acrylic lens cover. Lighting shall provide a minimum of fifty (50) foot candles at floor level.

B. **Exterior Lighting:** Install a vandal resistant sevety (70) watt High Pressure Sodium exterior light above each door, equipped with acrylic lens cover, and controlled by a built-in photocell.

C. **Emergency Lighting:** Wall mounted emergency lighting to be installed in the quantity shown on the drawings. Lights to be dual head, ninety (90) minute back up, with lamps included.

D. **Exit Signs:** Red LED exit signs to be provided above each exterior door, if required by Code.

## 2.10 RECEPTACLES

A. **Interior Receptacles:** Wall mounted twenty (20) amp, one hundred twenty five (125) VAC duplex receptacles, installed in the quantity indicated on the drawings, with standard Ivory cover plates. Install at eighteen (18) inches above floor level or as shown on the drawings.

B. **Exterior Receptacles**. Weatherproof, twenty (20) amp, one hundred twenty five (125) VAC, GFI protected duplex receptacles. Install where shown on the drawings.

## 2.11 SWITCHES

A. Twenty (20) amp, wall mounted with standard Ivory cover plates, at forty-four (44) inches above floor, or as shown on the drawings.
B. Standard single pole except for interior lighting which shall be three (3) way.

## 2.12 ALARMS

A. Install a ceiling mounted one hundred twenty (120) VAC smoke detector and relay.
B. Install a magnetic contact entry alarm at the exterior door.
C. All alarms shall be wired to a wall mounted enclosure NEMA rated for high moisture environment, with terminal blocks mounted and alarms.

## 2.13 CABLE TRAY

A. Install an aluminum ladder type cable tray system in a layout and size as indicated in the drawings. Cable tray to be mounted from a reinforced ceiling using uni-strut and threaded rods. Load capacity of the cable tray shall, at a minimum, meet NEMA Class "C" (one hundred [100] pounds per lineal foot). The bottom of the cable tray shall be eight and one-half (8-1/2) feet from the floor.

## 3.0. EXECUTION

## 3.1 FOUNDATIONS

A. Install the foundations per the approved, sealed drawings as prepared by the Contractor-retained Illinois Structural Professional Engineer. Deviations from these sealed drawings shall not be made without the written approval of the sealing Engineer.

## 3.2 BUILDING

A. The building shall be installed per the installation drawings provided by the building manufacturer. Deviations from these sealed drawings shall not be made without the written approval of the sealing Engineer and the building manufacturer.

## 3.3 BUILDING COMMISSIONING

A. All building systems and components shall be operated in the manner that demonstrates their ability to be operated as designed and required. This commissioning shall be performed with the Engineer in attendance.
B. All warranties, guaranties, Operation and Maintenance Manuals and other required information shall be provided to the Engineer prior to final acceptance of the Work by the Engineer.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SCOPE

A. This specification provides requirements for tanks to be furnished and installed as part of the groundwater extraction & treatment system including the following:
   1. Steel, epoxy lined, four thousand three hundred (4,300)-gallon capacity rectangular groundwater holding tank.

### 1.2 RELATED WORK

A. Drawings.

### 1.3 REFERENCES

A. AWWA D100 Welded Steel Tanks for Water Storage.
B. AWWA D102 Coating Steel Water-Storage Tanks.
C. AWWA D103 Factory-Coated Bolted Steel Tanks for Water Storage.

### 1.4 SUBMITTALS

A. Shop Drawings:
   1. Tank and Fitting Material, including resin manufacturer data sheet, fitting material, gasket style and material, bolt material.
   2. Dimensioned tank drawings, including location and orientation of openings, fittings, accessories, restraints and supports, details of inlet and outlet fittings, manways, flexible connections and vents.
   3. Factory test report

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. All fittings and flange faces shall be protected from damage by covering them with material.
B. Pipe, tubing, fittings and miscellaneous small parts shall be packaged. Loose items, which may scratch the interior surface, shall not be placed inside the tank during shipment. Additional protection, such as battens, end wrapping, cross bracing or other interior fastenings may be required to assure that each individual piece of equipment is not damaged in transit.

### 1.6 QUALITY ASSURANCE

A. The tank manufacturer shall provide design drawings, plans, and specifications of the tank showing all openings and sealed by a Professional Engineer licensed in the State of Illinois.
B. Tanks shall be manufactured from virgin materials.
C. Tanks shall comply with AWWA.

D. The finished surface of the tanks shall be free from visual defects such as foreign inclusions, pin holes, craters or cracking that may impair the serviceability of the tanks.

## 1.7 WARRANTY

A. All equipment shall be warranted to be free of defects in material and workmanship for a period of one (1) year from the date of acceptance by the Engineer.
B. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the manufacturer shall repair or replace such defective part.

## 2.0 PRODUCTS

## 2.1 ABOVEGROUND STEEL STORAGE TANK

A. Capacity listed in specifications and on Drawings shall be usable capacity.
B. Uniform roof loads shall be thirty (30) psf minimum.
C. Operating temperature range shall be minus twenty (-20) to one hundred fifty (150) degrees Fahrenheit minimum.
D. Minimum gage thickness shall be ten (10) gage construction.
E. Minimum roof and wall thickness shall be three-sixteenths (3/16) inch. Minimum bottom plate thickness is one-quarter (1/4) inch.
F. Material of construction shall be carbon steel.
G. Interior Lining shall be White Epoxy with minimum thickness of four (4) Mils.
H. Openings shall be as shown on Drawings, to include at a minimum:
   1. One (1), thirty (30) inch diameter manhole with cover and hardware.
   2. One (1), four (4) inch flange for roof vent connection.
   3. Four (4), one and one-quarter (1-1/4) inch NPT level sensor connections.
   4. Twelve (12), two (2) inch flanges for inlet (force main and sump) pipe connections.
   5. One (1), six (6) inch flange for discharge (transfer pump) pipe connection.

## 3.0 EXECUTION

## 3.1 INSTALLATION

A. Tanks shall be installed in accordance with the manufacturer's recommendations.

## 3.2 TESTING

A. Contractor shall notify the Engineer at least three (3) business days in advance of all tests. All tests shall be conducted to the Engineer's complete satisfaction.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SCOPE

A. Furnish all labor, materials, equipment, and incidentals required to install and field test, in the locations shown on the Drawings or described in these Specifications, all pipe and fittings shown, described, or implied herein.

### 1.2 RELATED REQUIREMENTS

A. Section 01330 – Contractor Submittals.

### 1.3 SYSTEM DESCRIPTION

A. The Contractor shall furnish and install all pipe and fittings for all piping as shown on the Drawings and as specified herein.
B. Piping specifically shall include all gas collection system and stormwater collection and conveyance piping; and all fittings and accessories required for completely connected, properly operating installations.
C. Also included under this section are jointing materials, gasketing materials, and other miscellaneous pipe accessories required for piping systems as specified herein.

### 1.4 IDENTIFICATION OF PIPE AND VALVES

A. Each piece of pipe and each fitting shall be marked plainly by the manufacturer with the type, class, number, and weight of pipe.

### 1.5 SUBMITTALS

A. Complete record set of reproducible Drawings showing all piping with approved modifications.

### 1.6 PROTECTION OF EQUIPMENT

A. The Contractor shall protect all pipe and accessories from damage at all times during construction and until the final acceptance of the completed project by the Engineer. Pipe openings in partially completed lines or existing lines shall be closed with plugs or caps during installation or modification.

## 2.0 PRODUCTS

A. Products shall be as described in the applicable sections of the Specifications and Drawings.

## 3.0. EXECUTION

### 3.1 GENERAL

A. All pipes, fittings, and accessories shall be installed by skilled workers and in a workmanlike manner, ensuring a complete, workable system in all respects, which operates satisfactorily. All piping installations shall be erected to accurate lines, grades, and pitches, and shall be supported adequately, as shown, specified, or required.

### 3.2 TESTING

A. All pipe, fittings, and accessories shall be tested in the manner hereinafter specified. All tests shall be performed by the Contractor and shall be conducted as directed by the Engineer.

B. The Contractor shall furnish all labor, materials, equipment, and services required for making tests, as specified, including pumps, gauges, thrust protection, temporary bulkheads, and other miscellaneous items required. No piping shall be insulated or concealed until satisfactory completion of testing.

C. Testing shall be performed in such a manner to avoid injury or damage to other equipment, work, or surrounding territory. Devices that could be damaged by the test shall be isolated or removed from the system during the testing periods.

D. Piping that conveys water or aqueous solutions shall be pressure tested using air. The internal pressure test shall be made to the extent deemed necessary by the Engineer to determine the tightness of the piping systems.

E. Pressure systems will be tested by subjecting the piping to a minimum pressure of one-hundred (100) psig. The pressurized system must hold constant pressure for a period of not less than one (1) hour.

F. Non-pressure systems will be tested by subjecting the piping to a minimum pressure of ten (10) psig, unless specified otherwise in other Sections. The pressurized system must hold constant pressure for a period of not less than twenty (20) minutes.

G. Test report documentation should be generated for each test. The documentation should state the test date; description and identification of piping tested; test fluid used; test pressure at the test start and test end; test start time and end time; and remarks, including type and location of leaks and repair and replacement performed. The report documentation shall be signed by the Contractor and Engineer to represent that the test was satisfactorily performed.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SUMMARY

A. This section provides requirements for piping, pipe sleeves, and pipe supports.

### 1.2 RELATED WORK

A. Section 15050 – Basic Materials and Methods for Piping.
B. Drawings.

### 1.3 REFERENCE STANDARDS

A. ASTM A 53/A 53M Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
B. ASTM D 1784 Rigid PVC Compounds and CPVC Compounds.
C. ASTM D 3261 Heat Fusion Polyethylene Plastic Fitting for PE Plastic Pipe and Tubing.
D. ASTM D 3350 Specification for Polyethylene Plastics Pipe and Fittings Material.
E. ASTM F 439 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
F. ASTM F 493 Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
G. ASTM F 656 Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
H. MSS SP-89 Fabrication and Installation of Pipe Supports.
I. MSS SP-58 Materials and Design of Pipe Supports.
J. MSS SP-69 Selection and Application of Pipe Supports.
K. ASME B31.3 Chemical Plant and Petroleum Refinery Piping.

### 1.4 SUBMITTALS

A. Manufacturer's catalog data for pipe and fittings.
B. Installation Drawings.

## 2.0 PRODUCTS

### 2.1 FORCE MAIN PIPING

A. Pipe and fittings from the extraction wells to the ISCA P&T building shall be as follows, except where noted on the Drawings:
   1. Well Riser Pipe: Black carbon steel, seamless or electric resistance welded, Schedule 40 in accordance with ASTM 53/A 53M, from the extraction well pump to the pitless adapter. Pipe diameters shall be as indicated on the Drawings.

2. Conveyance Pipe: Single-wall, SDR9 HDPE pipe in accordance with ASTM D 3350 and ASTM D 3261 from the wells (after the pitless adapter) to the building foundation as shown on the Drawings. Pipe diameters shall be as indicated on the Drawings.
3. HDPE Joints: Shall be butt-fused and shall be performed in accordance with ASTM D 3261, and appropriately sized for the individual pipe run.

## 2.2 ISCA PUMP AND TREAT SYSTEM PIPING

A. Pipe and fittings within the ISCA P&T building shall be as follows, except where noted on the Drawings:
   1. Groundwater process pipe: Schedule 80 PVC in accordance with ASTM D 1784 and ASTM F 439. Pipe diameters shall be as indicated on the Drawings.
   2. Equalization tank vent pipe: Black carbon steel, seamless or electric resistance welded, Schedule 40 in accordance with ASTM 53/A 53M. Pipe diameter shall be as indicated on the Drawings.
   3. PVC joints: Shall be glued in accordance with ASTM F 493 and ASTM 656, and appropriately sized for the individual pipe run.

## 2.3 PIPE SLEEVES

A. Pipe sleeves of sufficient length to pass through building foundation or walls shall be provided. Pipe sleeves shall be zinc-coated steel pipe, conforming to the requirements of ASTM A 53/A 53M, Schedule 40.
   1. The pipe sleeves shall be secured in the proper position and location during construction of the foundation or building wall.
   2. The pipe sleeve shall be sized to accommodate the specific mechanical seal size used for the conduit penetration.
   3. The space between the sleeve and pipe casing, and the caulking and sealing materials shall be selected so there shall be no electrical continuity between the pipe sleeve and pipe casing.

## 2.4 PIPE SUPPORTS

A. Pipe supports shall be in accordance with MSS SP-58 and MSS SP-69. All pipe supports, including structural cross support members, shall be galvanized. Chains, straps, or single point supports shall not be used.

## 3.0. EXECUTION

A. Pipe shall be installed as indicated and specified in accordance with manufacturer's recommendations; federal, state, and local codes; ASME B31.3; and Section 15050, BASIC MATERIALS AND METHODS FOR PIPING; and other applicable sections of this Specification.

B. Pipe supports shall be fabricated and installed in accordance with ASME B31.3, MSS SP-58, MSS SP-69, and MSS SP-89. Supports shall be provided as necessary to limit pipe spans to achieve a maximum ten-one-hundredths- (0.10-) inch sag between supports when pipe is filled with water. Supports shall be placed as close as possible to concentrated loads and adjacent to any change in direction of the piping.

C. For threaded connections, use Teflon tape thread sealant or manufacturer's recommended sealant compatible with chemicals of concern.

D. Where dissimilar materials are joined together, the joint shall be the type of adapter and technique as recommended by the pipe manufacturer.

E. Test installed pipe in accordance with Section 15050, BASIC MATERIALS AND METHODS FOR PIPING.

F. Use of ninety- (90-) degree and forty-five- (45-) degree elbows will be kept to a minimum. The Contractor shall utilize the inherent flex of the HDPE pipe whenever possible. It is the responsibility of the Contractor to ensure that manufacturer's requirements for maximum flexing or bending of any pipe is not exceeded. Flexing shall not be forced, and any breaks or breaches of any type pipe and/or joints shall be repaired immediately by the Contractor at his/her own cost and at no cost to the Agency.

*** END OF SECTION ***

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## 1.0 GENERAL

### 1.1 SUMMARY

A. This section includes the minimum requirements for the supply and installation of valves to be installed as part of the piping network. Valves shall be installed as indicated on the Drawings.

B. This section covers the valves and appurtenances as follows:
   1. Globe valves.
   2. Ball valves.
   3. Check valves.
   4. Pressure reducing valves
   5. Air/vacuum relief valves
   6. Manual operators.
   7. Quick-connect couplings.
   8. Pitless Adapters.

### 1.2 RELATED WORK

A. Section 01620 – Storage and Protection.

B. Section 15050 – Basic Materials and Methods for Piping.

C. Drawings.

### 1.3 REFERENCE STANDARDS

A. ASTM D1784 Rigid PVC Compounds and CPVC Compounds.

B. ASTM B16.34 Valves; Flanged, Threaded, and Welded End.

C. ASME B31.3 Chemical Plant and Petroleum Refinery Piping.

### 1.4 SUBMITTALS

A. Complete Specifications, data, catalog cuts, or drawings covering the items furnished under this section, including complete connection and schematic wiring diagrams for electric actuators and controls. Include product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions, weight and required clearances, and installation instructions. Include list indicating valve and its application.

B. Maintenance data for valves. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

C. Certification that valves have been shop-tested as specified in Section 15050, BASIC MATERIALS AND METHODS FOR PIPING.

D. A list of manufacturer's recommended spare parts.

E. Documentation of chemical resistance of valve materials of construction.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and grooves.
   3. Set gate valves closed to prevent rattling.
   4. Set ball valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Store indoors unless outside storage is approved by the Engineer and maintain valve temperature higher than ambient dew-point temperature.
   2. If outdoor storage is approved, store valves off the ground in watertight enclosures.

C. Store equipment and materials as specified in Section 01620, STORAGE AND PROTECTION.

## 1.6 TOOLS

A. Supply special tools, if required for normal operation and maintenance.

## 2.0 PRODUCTS

## 2.1 VALVES AND ACCESSORIES

A. General:
   1. All valves and appurtenances shall be of the size indicated and, as far as possible, all items of the same type shall be from one manufacturer.
   2. All valves and appurtenances shall have the name of the manufacturer, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
   3. Length Tolerance. Unless otherwise specified, the actual length of valves shall be within plus or minus one-sixteenth (1/16) inch of the specified or approved length.
   4. Ends. Unless otherwise indicated on the drawings or specified, all two and one-half- (2-1/2-) inch or larger valves shall have flanged ends; and all two- (2-) inch or smaller valves shall have threaded ends. Unless otherwise indicated on the drawings, flange diameter and drilling shall conform to ANSI/ASME B16.5, Class 150. Mechanical joints shall conform to ANSI/AWWA C111/A21.11.
   5. Unions. A union or a flanged connection shall be provided within two (2) feet of each threaded end valve unless the valve can be easily removed from the piping.
   6. Chemical resistance. All valves shall be constructed of materials chemically resistant to the anticipated contaminants and process chemical additives.

B. Globe Valves: Globe valves shall be installed for efficient throttling of flow. Globe valves shall be outside stem & yoke type constructed of PVC with no metal part that comes in contact with process water Globe valves shall be as manufactured by Asahi/America, Inc. or approved equal

C. Ball Valves: All valves in PVC and CPVC piping shall be full-size port ball valves of the same material as the pipe with teflon seats, and union ends. PVC ball valves shall have Viton O-rings and CPVC ball valves shall have EPDM O-rings. Plastic ball valves shall be Nibco "Chemtrol TU Series Tru-Bloc Ball Valve" or Hayward Plastic Products "True Union Ball Valve". The port diameter shall be not smaller than the ID of Schedule 80 PVC pipe.

D. Check Valves: Check valves in PVC piping shall be PVC ball check valves with Viton seats and seals and flanged ends, and shall be Hayward Plastics Products "Ball Check Valve" or Nibco "Chemtrol True Union Ball Check Valve".

E. Pressure Reducing Valves: Pressure reducing valves prevent downstream pressure from exceeding a preset pressure. Valves shall be suitable for 100 psi operating pressure on the inlet side, with outlet pressure set for 10 psi from the factory. Pressure Reducing valves shall be as manufactured by Hayward Industrial Products, Inc. or approved equal.

F. Air/Vacuum Relief Valves: Vacuum and air relief valves in PVC piping shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow.

G. Manual Operators: Unless otherwise indicated, all valves and gates shall be furnished with manual actuators. Valves in sizes up to and including six (6) inches shall have direct acting lever or handwheel actuators of the Manufacturer's standard design.

H. Pitless Adapters: Pitless adapters shall be constructed of red brass and shall match the size of the force main to which attached. Merrill Manufacturing Heavy Duty Model MHB300 or Engineer approved equal.

I. Sample Valves: All thermoplastic valves shall be lab constructed from PVC Type I Cell classification 12454 or CPVC Type IV Cell Classification 23447. O-rings shall be EPDM, Viton. Valves shall have a double stop polypropylene handle and a field installable male thread to hose ninety (90)-degree elbow end connector adapters. Valves shall be pressure rated at 150 psi for water at 73 degrees F. Asahi/America Labcock Valves from Indelco Plastics Corporation or engineer approved equal.

## 2.2 QUICK CONNECT COUPLINGS

A. Quick connect couplings shall be of the cam and groove type consisting of a male adapter. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures up to 100 psig. Each adapter shall be furnished with a dust cap complete with a 18-inch- long security stainless steel chain. Couplings shall be constructed of Type 316 stainless steel material. Couplings shall be as manufactured by Dover Corp./DPW Divisions, Andrews of Dayton, N.J. or equal.

## 3.0. EXECUTION

### 3.1 INSTALLATION

A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported.
B. After installation, all valves and appurtenances shall be tested per Section 15050, BASIC MATERIALS AND METHODS FOR PIPING at least one (1) hour at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired to the satisfaction of the Engineer.
C. All materials shall be carefully inspected for defects in workmanship and materials; all debris and foreign material cleaned out of valve openings, etc.; all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment that do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
D. Valves shall be installed in accordance with Manufacturers' recommendation; federal, state, and local codes; ASME B31.3; and applicable requirements of Section 15050, BASIC MATERIALS AND METHODS FOR PIPING.

### 3.3 INSPECTION AND TESTING

A. Testing shall be performed in accordance with Section 15050, BASIC MATERIALS AND METHODS FOR PIPING.
B. The various pipelines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.
C. Various regulating valves and other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and all deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

*** END OF SECTION ***

## 1.0 GENERAL

### 1.1 SCOPE

A. Furnish all labor, materials, equipment, and incidentals required to install and field test, in the locations shown on the Drawings or described in these Specifications, all meters and gages shown, described, or implied herein.

### 1.2 RELATED WORK

A. Section 11010 – General Equipment Requirements.
B. Drawings.

### 1.3 SYSTEM DESCRIPTION

A. The Contractor shall furnish and install all meters, gages, fittings, hangers, and supports for all process meters and gages as shown on the Drawings and as specified herein.
B. The Contractor also shall furnish, install, and test, complete and ready for operation, all valves, operators, levers, and other appurtenances required.
C. Also included under this section are hangers, supports, bolts and nuts, jointing materials, gasket materials, and other miscellaneous meter and gage accessories required or as specified herein.
D. The equipment listed in this specification accompanies the systems specified in other Sections. Products in this section could be similar to products specified in other sections. For products that are similar, provide the same make and appropriate model numbers as those provided with these systems. If the equipment supplied at the time of construction differs from the design equipment, the Contractor shall provide all modifications to the drawings as necessary to update the system design to reflect the changes.

### 1.4 IDENTIFICATION OF METERS AND GAGES

A. Each meter and gage shall be marked plainly according to Identification of Equipment in Section 11010, GENERAL EQUIPMENT REQUIREMENTS.

### 1.5 SUBMITTALS

A. Product Data: Include scale ranges, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
B. Shop Drawings: Include a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams; single line drawings; fabrication drawings; equipment layout and anchorage; and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

C. Product Certificates: Signed by manufacturers of meters and gages certifying accuracy under specified operating conditions and compliance with specified requirements.
   1. Maintenance Data: For meters and gages to include in maintenance manuals.

## 1.6 PROTECTION OF EQUIPMENT

A. Contractor shall protect all meters, gages, and accessories from damage at all times during construction and until the final acceptance of the completed project by the Agency. Pipe openings shall be closed with plugs or caps during installation or modification. Meters and gages shall be covered properly to avoid injury and shall be protected against dirt, water, or chemicals. Before the final acceptance of the project, all meters and gages shall be cleaned thoroughly and shall be in operational condition at the time of project turnover.

## 1.7 WARRANTY

A. Mechanical - warrant all equipment to be free of defects in material and workmanship for a period of one (1) year from the date of acceptance by the Agency.

## 2.0 PRODUCTS

A. Pressure Switch: Square D PumpTrol Water Pump Pressure Switch or Engineer-approved other. Diaphragm actuated pump designed for control of electrically driven water pumps.
B. Level indicators: W.E. Anderson Series L6 with DPDT contacts or Engineer-approved other. UL approved construction with weatherproof and explosion proof junction box. Level indicator shall have solid polypropylene float and brass lower body. Standard temperature limit of -4 degrees F to 220 degrees F. One (1) inch male NPT process connection.
C. Pressure Gauges: Dwyer Series SGL or Engineer-approved other. Pressure gauges shall be supplied with ranges as indicated on the Drawings. Accuracy of the gauge shall be one percent (1%) of the full range scale. Connection shall be male one-half (1/2)-inch NPT located at the bottom of the gauge. Gauges shall be rated for a maximum pressure of at least one hundred thirty percent (130%) of the full range scale. The dial shall be four and one-half (4-1/2) inch diameter, conforming to ASME B40.1 and shall be suitable for a temperature range of -13 degrees F to 149 degrees F. Wetted materials shall be a 316L stainless steel (SS) bourdon tube and socket and a SS connection block. The housing shall be 304 SS with a safety glass cover.
D. Totalizers: Badger Meter Inc. Recordall Series or Engineer-approved other.

## 3.0. EXECUTION

### 3.1 GENERAL

A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

B. All meters, gages, and accessories shall be installed by skilled workers and in a workmanlike manner, ensuring a complete, workable system in all respects, which operates satisfactorily and quietly. Install meters and gages upright or horizontal, not inverted. Install meters and gages such that the face is toward the operator and is not obstructed.

C. All meters and gages connecting to equipment shall be provided with unions or companion flanges located so that they may be dismantled readily from equipment. Connections between dissimilar metals in piping systems shall be made with dielectric unions of a type acceptable to the Agency.

D. All meters and gages not shown on the Drawings but required for, or connected to, equipment shall be arranged in a manner consistent with good design. Layout shall be neat and orderly, accessibility for maintenance being of prime importance.

### 3.2 PRESSURE GAGE INSTALLATION

A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.

B. Install pressure-gage needle valve and snubber in piping to pressure gages.

### 3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
   1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
   2. Connect flow-measuring-system elements to meters.
   3. Connect flow meter transmitters to meters.

B. Make electrical connections to power supply and electrically operated meters and devices.

C. Ground electrically operated meters.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

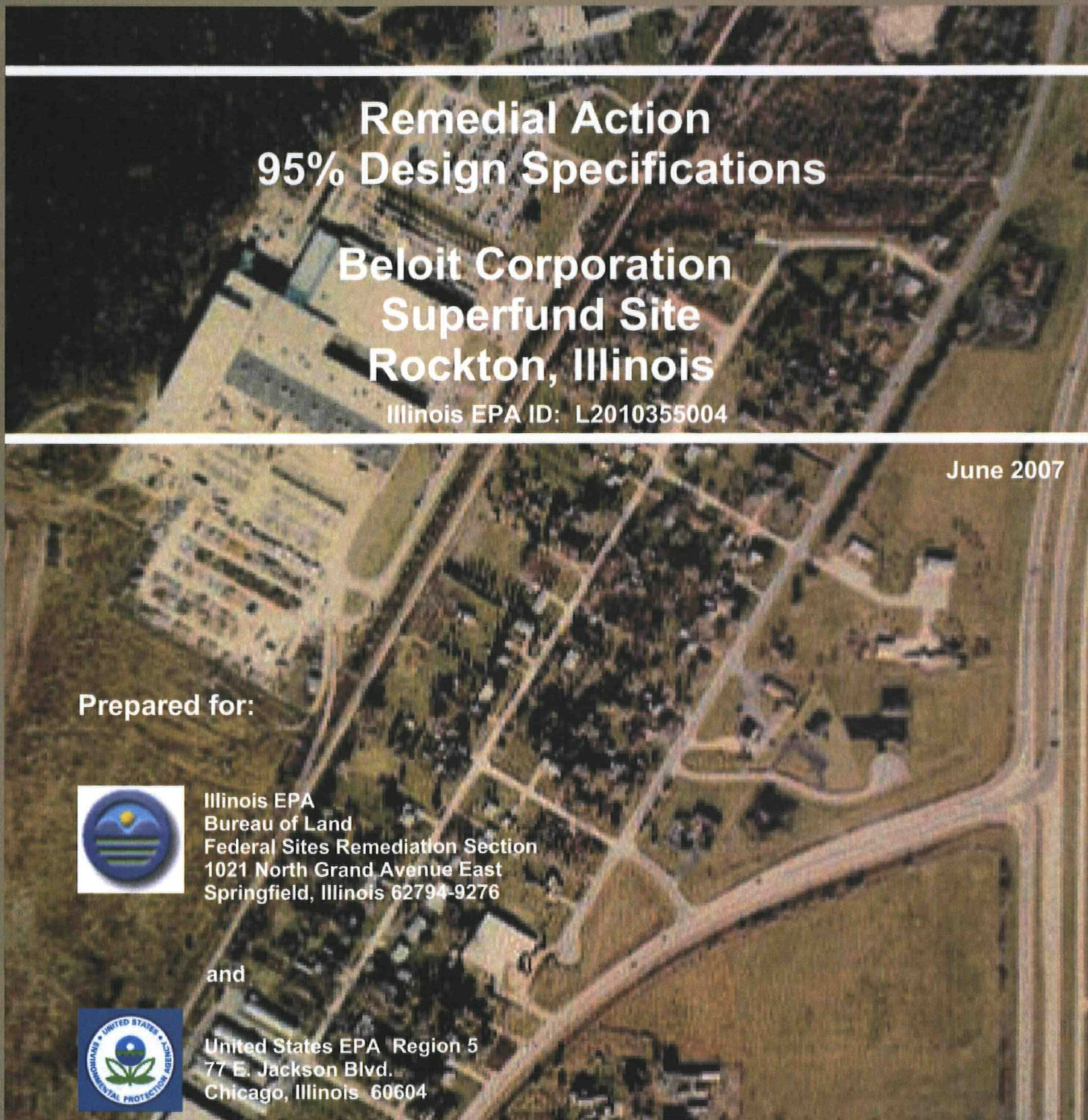
E. Install electrical connections for power and devices.

F. Electrical power, wiring, and connections are specified in Division 16 Sections.

## 3.4 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturers written instructions, after installation.
B. Adjust faces of meters and gages to proper angle for best visibility.
C. Clean windows of meters and gages and clean factory-finished surfaces.
D. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

*** END OF SECTION ***



# Remedial Action
# 95% Design Specifications

## Beloit Corporation
## Superfund Site
## Rockton, Illinois

Illinois EPA ID: L2010355004

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**Prepared for:**

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